Navy Record See - Pa

6 AUG 2 0 1957
Cont. Copy

SCIENCE

16 August 1957
Volume 126, Number 3268

50[illegible]

Editorial The Voice of the Reader 285

Articles Collective Capitalism and Economic Theory: *G. C. Means* 287

J. G. Hamilton, Medical Physicist and Physician: *E. O. Lawrence* and *W. M. Garrison* 294

News of Science News Articles and Briefs; Scientists in the News; Recent Deaths 295

Reports Hemoglobin M: *P. S. Gerald, C. D. Cook, L. K. Diamond* 300

Nonspecific Inhibition of Vaccinia Hemagglutinin: *W. A. Cassel* and *B. Fater* 301

Production of Laminar Lesions in the Cerebral Cortex by Heavy Ionizing Particles: *L. I. Malis* et al. 302

Reversal of Inhibitory Effects of Ozone on Oxygen Uptake of Mitochondria: *H. T. Freebairn* 303

Effect of Lysergic Acid Diethylamide on Absolute Visual Threshold of the Pigeon: *D. S. Blough* 304

Age of the Sandia Culture: *H. Gross* 305

Heterogeneity of Nuclear Ribonucleic Acid: *W. S. Vincent* 306

Homing in Bats: *H. C. Mueller* and *J. T. Emlen, Jr.* 307

Ethylenediaminetetraacetate and Mitochondrial Adenosine Triphosphatase Activity: *R. W. Von Korff* 308

Some New Whiskers: *E. F. Riebling* and *W. W. Webb* 309

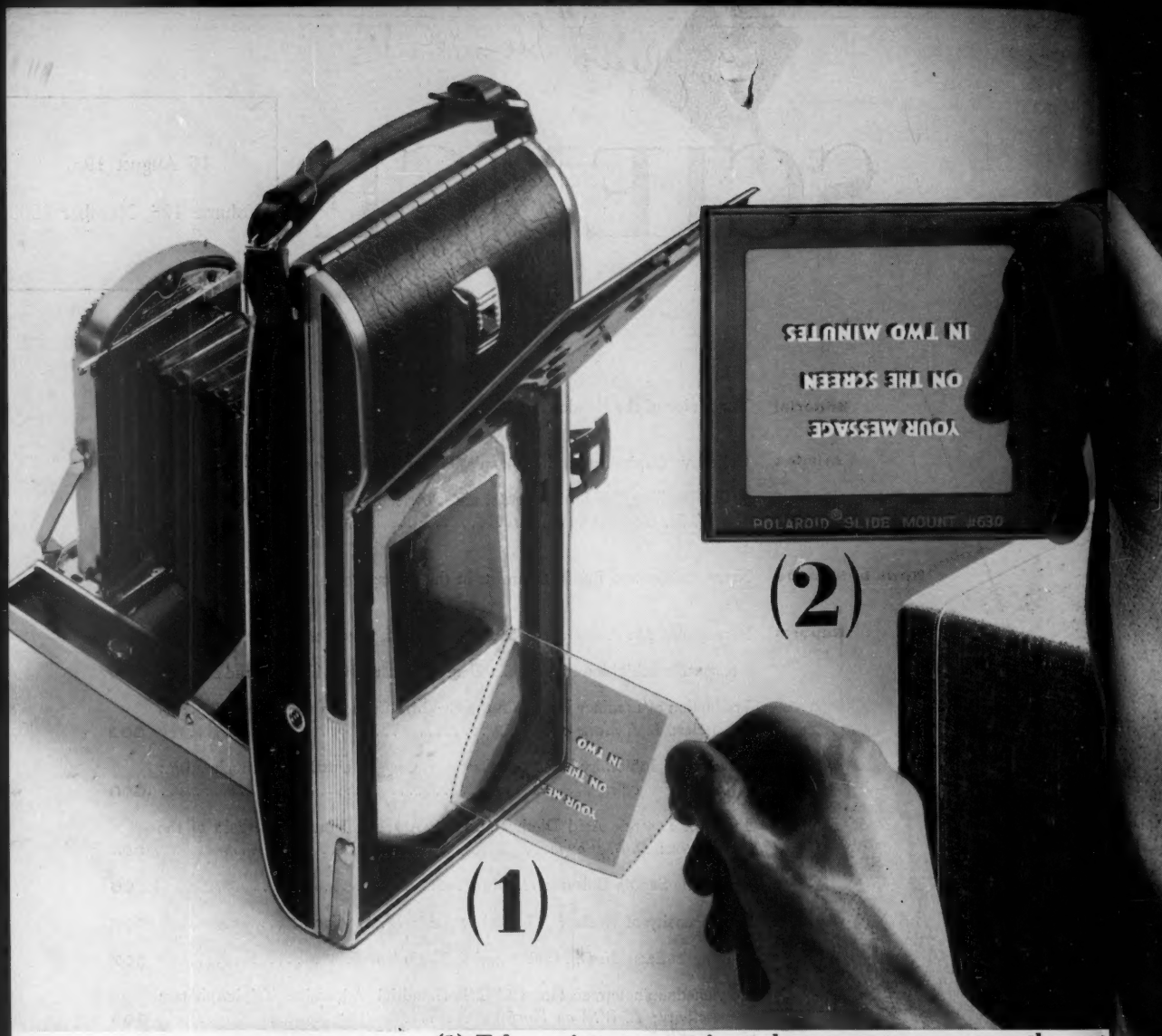
Evidence Concerning the Size of Amino Acid Incorporation Structures in *Escherichia coli*: *F. Hutchinson, H. Morowitz, E. Kempner* 310

Book Reviews *The Prospects of Nuclear Power and Technology; Faune de France, 60, Bryozoaires; Vapour Phase Chromatography; Handbuch der Physik; The Theory of Groups; Scientific Inference; A Symposium on the Chemical Basis of Heredity; Professional Amateur*; New Books; Miscellaneous Publications ... 311

Meetings and Societies Antibiotics; National Council of Teachers of Mathematics; Meeting Notes; Society Elections; Forthcoming Events 315

Equipment News 320

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



(1) Take a picture one minute, have your transparency the next.

Polaroid Corporation Announces

Now you can make slides right in your office, laboratory or classroom—and have them ready to project in minutes.

Polaroid Corporation has perfected a film which produces black-and-white slides right in the camera. You simply load a *regular* Land camera with this new film, click the shutter, pull a tab and lift out a transparency of exceptional photographic quality. It's ready to project 20 seconds later, after a quick hardening and mounting in a snap-together plastic mount. It's now as easy to use slides in your work as it is to pick up a phone or dictate a letter.

The complete system includes the standard Polaroid® Land Camera, the film, mounts, hardener and projector, plus a versatile Copymaker that lets you make slides from any text material, existing photographs, charts, graphs, titles or what have you. You have a choice of two sizes of film—2¼ x 2¼, or 3¼ x 4 (for existing "Lantern Slide" projectors). The quality of the film is remarkable—brilliant, grainless, and so sharp that projection to 12-foot

(2) Simply slip it into a mount, and (3) project it as big as you want.

Immediate Transparency System

screens shows no loss of detail. And it's extraordinarily fast (speaking photographically, now)—daylight speed of 1000 (ASA equivalent exposure index).

The slides cost about one-third as much as conventional slides. But the real saving is in the time and effort that it takes to put a picture on the screen. Whenever you've been on your feet before a group, you've felt the need for a key picture (or perhaps several) to make sure your information gets across. Now you can make those pictures right in your office, classroom or laboratory and begin to use your listeners' eyes as well as their ears. Send in this coupon for more detailed information.

Polaroid Corporation
Dept. S-8 • Cambridge 39, Massachusetts

Please send me detailed information on the new Polaroid Transparency System.

Name_____

Profession or Position_____

Institution or Company_____

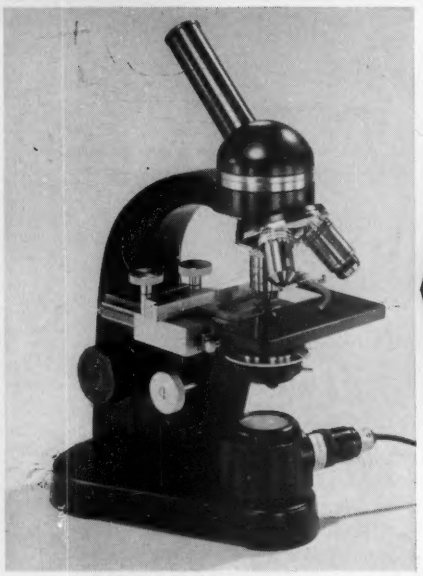
Address_____

City_____ Zone_____ State_____

POLAROID CORP., CAMBRIDGE, MASS.

RECOMMENDED BY LEADING MEDICAL SCHOOLS AND BY HOSPITALS AND LABORATORIES

Leitz STUDENT AND LABORATORY MICROSCOPES



the new Medical and Laboratory Microscope SM

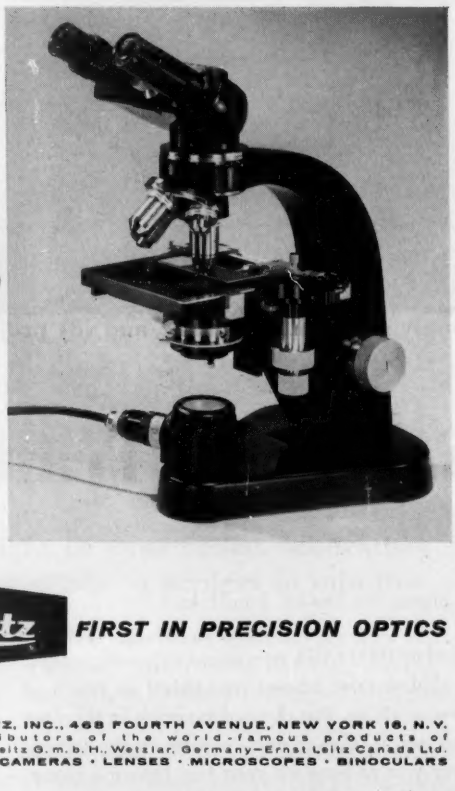
A new standard in general purpose instruments, the Leitz SM is the ideal microscope for the medical student, and for classroom and medical laboratory use. Combines handsome, solid construction with operational ease and precision. Features single-knob, dual-focusing control for coarse and fine focusing by raising and lowering the stage. Tube changing device is instant-locking, securing positioning of all tubes (inclined or straight monocular or binocular) in a one-step operation. A variety of object stages may be selected, and attachable illuminators are interchangeable with mirror.

MEDICAL AND LABORATORY MICROSCOPE SM, with inclined monocular tube, mechanical stage; two-lens condenser with swing-out upper element and iris diaphragm; quadruple nosepiece; mirror and fork; carrying case. With optical unit consisting of achromats 3.5x, 10x, 45x, and 100x oil immersion, the last two with spring-loaded mounts; 6x and 10x eyepieces $407.50

the Labolux

A convertible monocular-binocular microscope that is the ultimate in fatigue-free precision operation. The LABOLUX is suitable not only for the student, but recommended for later use in office practice, hospital or laboratory, where further requirements are readily fulfilled by this instrument's versatility. The LABOLUX features coarse and fine focusing adjustments combined in a single control; low-position controls for ease of operation; adaptability to various types of illumination, various object stages and photomicrography; instant-locking tube changing device that secures positioning of all tubes in a one-step operation.

LABOLUX S 47/92-15 inclined binocular microscope, with built-in mechanical stage #47, Abbe condenser; quadruple nosepiece with achromats 3.5x, 10x, 45x, and 100x oil immersion, the last two having spring-loaded mounts; paired 6x and 10x binocular eyepieces; with carrying case.....$696.50



E. Leitz, Inc., Dept. SC-8
468 Fourth Avenue, New York 16, N.Y.

Please send me additional information on the
☐ SM Microscope ☐ LABOLUX Microscope

Name_____

Street_____

City_____ Zone___ State_____

Leitz *FIRST IN PRECISION OPTICS*

E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N.Y.
Distributors of the world-famous products of Ernst Leitz G. m. b. H., Wetzlar, Germany—Ernst Leitz Canada Ltd.
LEICA CAMERAS · LENSES · MICROSCOPES · BINOCULARS

20857

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of 3 March 1879. Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢.

16 August 1957, Volume 126, Number 3268

SCIENCE

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

LAURENCE H. SNYDER, *President*
WALLACE R. BRODE, *President Elect*
PAUL B. SEARS, *Retiring President*
PAUL M. GROSS
GEORGE R. HARRISON
PAUL E. KLOPSTEG
CHAUNCEY D. LEAKE
MARGARET MEAD
THOMAS PARK
WILLIAM W. RUBEY
ALAN T. WATERMAN
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Executive Officer*

DAEL WOLFLE, *Executive Officer*
GRAHAM DUSHANE, *Editor*
CHARLOTTE V. MEETING, *Associate Editor*
JOSEPH TURNER, *Assistant Editor*

Editorial Board

WALLACE R. BRODE — EDWIN M. LERNER
BENTLEY GLASS — WILLIAM L. STRAUS, JR.
KARL LARK-HOROVITZ — EDWARD L. TATUM

Editorial Staff

PATRICIA L. CARSON, MARY L. CRABILL, HARRY DAVID, SARAH S. DEES, NANCY S. HAMILTON, OLIVER W. HEATWOLE, YUKIE KOZAI, ELLEN E. MURPHY, ROBERT V. ORMES, BETHSABE PEDERSEN, MADELINE SCHNEIDER, JANE STINE, JACQUELYN VOLLMER

EARL J. SCHERAGO, *Advertising Representative*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature* and in the *Industrial Arts Index*.

Editorial and personnel-placement correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts, book reviews, and illustrations, see *Science* 125, 16 (4 Jan. 1957).

Display-advertising correspondence should be addressed to SCIENCE, Room 740, 11 West 42 St., New York 36, N.Y.

Change of address notification should be sent to 1515 Massachusetts Ave., NW, Washington 5, D.C., 4 weeks in advance. If possible, furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

Rates effective 1 January 1958: $8.50; foreign postage, $1.50; Canadian postage, 75¢. Single copies, 25¢.

The Voice of the Reader

A carpenter—a friend of long ago—discussed with his wife the details of the home they planned to build for themselves. Regretfully he concluded that he could not satisfy all her wishes, for what she wanted was a nice little house with a lot of great big rooms.

We feel a bit like the carpenter, for, figuratively, we have been listening to several thousand *Science* readers tell us what they want *Science* to be. Their replies to a questionnaire that we recently mailed to a ten-percent sample of AAAS members are generous, clear, sometimes pungent, and sometimes mutually contradictory. If we tried to comply with all of the most frequently made recommendations, *Science* would be no larger than it now is but would contain more news, more editorials, more review articles, more technical reports, and more articles on the relations of science to education, government, and social affairs; it would be less technical and broader in its coverage; would devote more attention to foreign books and news; and would be more like *Nature*, the *American Scientist*, and the *Scientific American*. This edition would do for most readers, but there would also have to be special editions for those who want *Science* to be less like these other magazines, those who want fewer technical articles, and those who want us to "cut down on political clap-trap."

When several thousand members express their divergent views on such a matter as editorial policy, it is always possible to find diametrically opposed recommendations. One could, in fact, select a rather ridiculously contradictory set of suggestions. But to do so would be to miss the opportunity to learn the consensus that underlies the variety. And consensus there is.

One recurring request is for more technical reports. Another is for more brief, authoritative reviews of the state of knowledge in active research fields—those difficult-to-find articles that are "scientific" but that are so written as to be understandable to scientists in other fields. A third is for more articles on the relations of science to education, government, and society. A fourth is a frequent plea for brevity; an industrial chemist wrote: "*Science*, slim, readable and pertinent . . . [is] read and enjoyed, while the overlarded ——— is regularly chucked into my wastebasket, unopened."

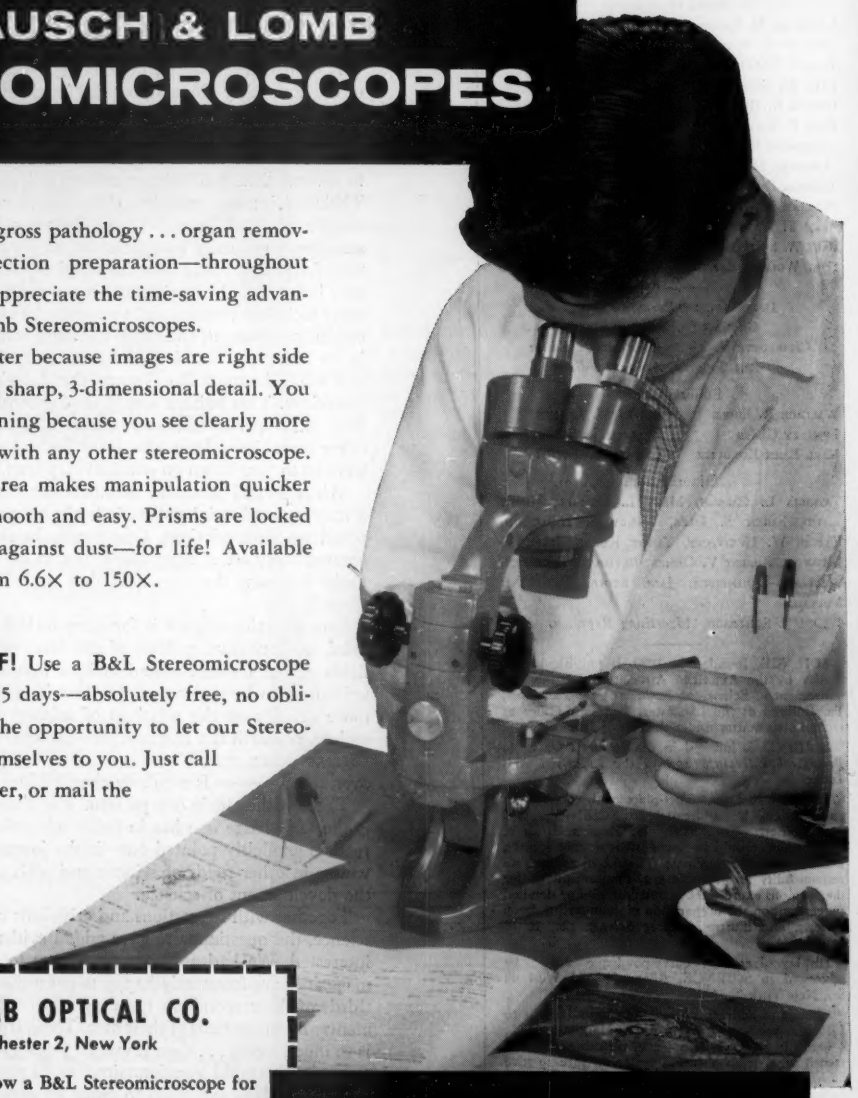
These wishes fit into a pattern. The time for reading is limited, and so is the knowledge one has in fields other than his own. *Science*—as many readers explicitly pointed out—is the journal to read to keep up with advances in other fields of science and with the forces of society that affect the development of science.

Together with suggestions and criticisms concerning individual aspects of science, the questionnaire gave added evidence that the readers are keenly interested. We had a 70-percent return to our questionnaire; commercial magazines are frequently happy to get a 30-percent return. Moreover, two-thirds of the respondents not only answered the questions but added comments and suggestions of their own. These free replies ranged from, "*Science* is so much worse . . . than it was 20 years ago that I see no use in filling out an obviously stupid questionnaire," to, "I prize my *Science*, adore its present style and if it is expanded to twice its present size I would simply double my reading time . . . make *Science* bigger, you can't make it *much* better."

In between these extremes were hundreds of thoughtful comments and suggestions for which the editorial staff is sincerely grateful. It will be impossible for us to comply with all of them, but we will keep the house as trim and compact as we can and will include as many great big rooms as we can squeeze in.—D. W.

FREE 15-DAY IN-YOUR-LAB TRIAL

BAUSCH & LOMB STEREOMICROSCOPES



Specimen analysis . . . gross pathology . . . organ removal for microtome section preparation—throughout your busy day you'll appreciate the time-saving advantages of Bausch & Lomb Stereomicroscopes.

Interpretation is faster because images are right side up and unreversed—in sharp, 3-dimensional detail. You spend less time positioning because you see clearly more of the specimen than with any other stereomicroscope. Extra-large working area makes manipulation quicker and easier. Focus is smooth and easy. Prisms are locked against shock, sealed against dust—for life! Available in magnifications from 6.6× to 150×.

SEE FOR YOURSELF! Use a B&L Stereomicroscope in your own lab for 15 days—absolutely free, no obligation. All we ask is the opportunity to let our Stereomicroscopes prove themselves to you. Just call your regular B&L dealer, or mail the coupon today.

BAUSCH & LOMB OPTICAL CO.
64220 St. Paul Street, Rochester 2, New York

☐ Yes, I'd like to borrow a B&L Stereomicroscope for a 15-day trial without cost or obligation.

☐ Send me B&L 3-D Micro-Vision Book, containing valuable data, showing actual stereo views.

Name.....

Title.....

Address.....

City..... *Zone*..... *State*.....

BAUSCH & LOMB
SINCE B&L 1853

America's only complete optical source . . . from glass to finished product.

16 August 1957, Volume 126, Number 3268 SCIENCE

Collective Capitalism and Economic Theory

Gardiner C. Means

The modern corporation has undermined the preconceptions of classical economic theory as effectively as the quantum undermined classical physics at the beginning of the 20th century. An equally drastic reconstruction of economic theory is due and is, perhaps, now in process. It is my purpose here to present a background for this reconstruction. This I propose to do by examining the relation between recent events and economic theory.

But first let us consider the role of theory in human action. In a basic sense man is a systematic animal. We live by systems of thought which guide our actions. Whether the particular system of thought is that of the witch doctor or the modern scientist, a system built around concepts of freedom and democracy or around a single God and the Ten Commandments, we could not live our lives effectively without such systems of thought. The real world is altogether too complex to be grasped. We build simplified systems of thought in order to aid our action. And these simplified systems are our theories about the real world.

Now it is a fundamental characteristic of our systems of thought that they never fit reality exactly. We can expect at best only a rough fit. A theory may be highly complex and logically consistent, and yet it is beyond wisdom to make it take account of *all* the real facts. As an approximation, a theory may serve us well. Newton's theory of gravity is sufficiently accurate for everyday purposes. But we should recognize that a theory can never be so complete as to give a perfect fit to reality.

In the field of the social sciences the crudeness in the fit of theory to reality is of particular importance because the social reality can itself be changing relative to the theory. I like to think of society as moving in a curve of change and a social theory as a straight line which may or may not be tangent to the curve at a particular time. When the theory is tangent to the curve, at that time the theory fits the reality well enough so that good policy can be made in terms of the theory, even though the theory does not exactly fit the facts.

In a period in which our social theories fit the facts reasonably well, we have the minimum of social tension. But then the social reality may change. The tangent of theory and the curve of reality get farther and farther apart. Policies made in terms of the theory fail to produce good results. Tensions increase, the theory itself becomes discredited, and there follows a period of groping for a new or revised theory which fits the new reality more closely. Then a new theory or set of theories emerges, and society is again squared away for a new period of effective policy and reduced tension.

I believe that we are now in a period in which society has moved out from under our older economic theories and that a new or revised set of theories is now in process of development. It is my purpose, here, to show why new theories are needed to guide policy and also to suggest some of the directions the new theories seem likely to take.

The "straight-line" character of social theory arises from the basic assumptions of any given theory. A given theory can be elaborated within the framework of its own logic, but it is confined to the limits of its own assumptions. More cannot be derived from a theory than is put in by assumption. Let us see how this works in the case of economic theory.

Types of Control over Production

For economic theorizing, we can distinguish between at least four basic types of nongovernmental production which differ as to who controls production and can imagine economic models, each made up of just one type of production.

We might assume a subsistence model in which each economic unit produces only for its own consumption and in which there is no buying and selling. In approximation, such a model describes the economic condition of the Virginia settlements before tobacco exports became a significant factor, it describes most of our early pioneer settlements as our population moved west, and it still applies to some mountain homesteads. But, more importantly, this model applies in considerable degree to more than half of the present-day population of the world—to the Indian village, to the African tribesmen, and to people in many other parts of the world. For such people the market plays a negligible role, and production is organized within the village or tribe on a collective basis to meet the needs of the producers who are also the consumers. In such subsistence economies, consumers are in control of production or, what is more significant for our present analysis, consumer, worker, owner, and management are combined in a single economic unit. As a result, production policy and the instruments of production are controlled by units which combine the interests of consumer, worker, owner, and management.

Or we might assume an economic model in which individuals produce goods for sale in the market and buy goods in the market for consumption but in which no one works directly for anyone else. In such an economy, price and the market serve to organize the production of separate economic units. This form of production is typified by most American farms—a single producer raising cash crops, selling the product into the market, and taking out of the market

The author is an economic consultant to the Committee for Economic Development, Washington, D.C. This article is based on a paper presented 27 Mar. 1957 at a session of the Marshall Wythe symposium at the College of William and Mary, Williamsburg, Va.

what he needs for production and for consumption. If all production were carried on by such one-man enterprises, we would have a pure atomistic economy, with the consumer no longer in direct control of production but influencing production only through the market. In such an economy, direct control over production policy and the instruments of production would rest with individuals who combine the interests of worker-owner-manager, while the interests of consumers would depend on market forces. It is the great achievement of Adam Smith that he presented a theory of market behavior for such an atomistic economy. I will come back to this in a moment.

A third type of economy which we might assume is one in which production is carried on under the factory system with individual factory owners managing production but hiring workers to do the main producing. In such an economy, not only the consumer but also the worker is separated from control over production policy and the instruments of production, except as consumer and worker affect production through the market. This system of production has properly been called private capitalism, and it was factory production which provided the basic assumption of Marxian theory, while the separation of the worker from control over the instruments of production provided the basis of his class struggle.

A fourth type of economic model which we might assume is one in which all production is carried on by great corporate units in which ownership is so widely dispersed that owners, as well as consumers and workers, are separated from control over production policy and the instruments of production. In such an economy, management would be in control, subject, of course, to the influence of the markets for goods, for labor, and for securities. And with the separation of ownership and control comes the possibility of great aggregations of productive activity. We now have single corporate enterprises employing hundreds of thousands of workers, having hundreds of thousands of stockholders, using billions of dollars' worth of the instruments of production, serving millions of customers, and controlled by a single management group. These are great collectives of enterprise, and a system composed of, or dominated by, them might well be called "collective capitalism."

It would be possible to elaborate other types of economy such as the Soviet Government ownership and control, or an economy of cooperatives, but those outlined here will serve the present purpose.

Actually, the history of Europe and America in the last four centuries roughly fits the pattern of these four economies, though at no period was the economy exclusively of one type or another. The feudal economy of Europe and the pioneer economies of America were primarily of the subsistence type; Adam Smith's 18th-century economy was dominantly atomistic; the 19th-century economy was dominated by the factory system; and today the big corporation gives its particular character to our modern economy. Let us then trace economic theory in relation to the curve of our changing economy.

Economic Theory and the Real Economy

We can begin with classical economic theory, which for present purposes starts with Adam Smith and comes down through Mill and Marshall but does not include Keynes. This body of theory, *in its essentials*, relates to an atomistic economy and never really grapples with the problems which make a factory economy different from an atomistic economy. This assertion may surprise some, since, certainly, the determination of wage rates was one of the classical problems. But consider that in classical theory, labor was treated as a commodity. In an atomistic economy, the shoemaker bought leather and shoe pegs and twine, combined them into a pair of shoes, and sold the shoes. And in classical theory the shoe manufacturer bought leather and shoe pegs and twine *and labor*, combined them into a pair of shoes, and sold the shoes. The factory system brought no change in theory except the delineation of a special commodity, labor, for which there were especially interesting problems of demand and supply. At the same time, the worker himself was treated as an entrepreneur seeking to market his "product"—labor.

A single example will help to underline this fact. Ever since I became aware of the limited basis of classical theory, I have sought cases where a classical scholar has made a *significant* theoretical point which would apply to a factory economy and could not apply to an atomistic economy. So far, prior to Keynes, I have found only a single case. It occurs in D. H. Robertson's brilliant little book, *Banking Policy and the Price Level* (*1*). Robertson points out that, if price and production policy in a company or an industry were made by the owners, one policy would result, whereas, if policy were made jointly by owners and workers, a different policy would result, with lower prices and larger volume, since, instead of seeking to maximize profits, the joint policy would seek to maximize the sum of profits and wages. Such a statement would make no sense in a prefactory system in which there was no separation of the worker from control over production policy.

Although there may be other examples of such a departure from the assumption of an atomistic economy, I believe they are few and far between and have not produced modifications in that theory. They do not stand in the way of the conclusion that, for practical purposes, classical theory is built on the basic assumption of an atomistic economy; we apply the classical analysis and classical conclusions to a factory or corporate economy at our peril.

Karl Marx took a big step forward in building his economic theory on the assumption of a factory economy and private capitalism. He recognized the separation of worker from control over the instruments of production and rejected the idea of treating labor as a commodity. In this he was more realistic than the classical theorists. On the other hand, he built a body of theory which has clearly been proved wrong in this country and certainly has not been supported so far by events in the Soviet Union. In this country, instead of progressive exploitation, there has been remarkable improvement in the workers' lot—the poor have become richer—while in the Soviet Union the workers are being exploited for the purposes of the state, with a real question whether the people are better off as a result. For Marx' theory, the superiority of his basic assumption of a factory economy does not make up for the weakness in his theoretical analysis.

As for collective capitalism, no comprehensive economic theory has been developed in terms of such an economy, in spite of the fact that the collective enterprise of our great corporations sets the tone of today's economy. As a result, we stand with a great deal of economic theory, but a major part of it was built on an obsolete base, and another part was disproved by events. It is clear to me that a major reconstruction of economic theory is in order. We must create a body of theory which applies to collective capitalism and modify it to the extent necessary to allow for the fact that not all enterprise is collective enterprise.

Steps toward the Reconstruction of Economic Theory

The first step in a reconstruction of economic theory is to define its scope in modern terms. As long as economics dealt only with a pure atomistic economy (or with the theoretical equivalent, a factory economy with labor treated as a commodity) the scope of economic theory could be limited to the market mechanism and to a consideration of the

ways in which individual behavior affected and in turn was affected by the market. For such an economy, an analysis of the market is also an analysis of the way in which the activities of separate individuals are coordinated in using resources to satisfy human wants. Some economists would like to limit the scope of economic theory today to the operation of the market mechanism. But today, with the great role played by corporate management in coordinating the activity of separate individuals within an enterprise, it is obvious that the market mechanism is not the only coordinating device. If we limit economic theory to the market, we are leaving out a major part of economic coordination. I believe that economic theory must be given the broader scope and that it must deal with economic coordination within enterprises as well as between enterprises. It must be concerned with the coordination of individual action in using resources to satisfy human wants, however that coordination is brought about.

If we accept this broad scope for economic theory, the second step is to investigate the various means by which economic coordination is brought about. So far, I have been able to discover four distinct and important ways by which the economic actions of individuals can be coordinated. The first and most obvious is the market mechanism. I do not need to point out how the market can coordinate the productive activity of thousands of individuals. A second and equally obvious method of coordination is by administrative direction. The manager tells *A* to do one thing, *B* another, and *C* a third, and, because the manager planned it that way, the separate actions of the three fall into a common pattern. But there are two other devices of coordination which are not so obvious, and yet they are particularly important for a democratic society. These devices are what might be called canalizing rules and the acceptance of common goals.

We are all familiar with the canalizing rules—the laws, rules, and customs—which help to coordinate daily living. The rule that one drives on the right side of the road or the custom that bills are sent out at the end of the month helps to bring order into individual behavior. Or consider two people getting into an elevator. It is much easier for a man and a woman to enter than it is for two polite men to do so. These are perhaps trivial examples. More important are the custom of accepting money in exchange for goods, the laws enforcing contracts, and the rules and regulations set up by a corporation to facilitate its activity. The canalizing rules play a major role in coordinating the activities of separate individuals.

The fourth coordinating influence is the acceptance of common goals. We had an outstanding example of this during World War II. There was a nation-wide acceptance of the aim of winning the war. And, in the light of this common goal, any number of people did things or put up with things in ways to contribute to the war effort without being told. Or take a more homely example. A family decides to go on a picnic and, without specific instructions, various members in the family start to prepare. Some make sandwiches, some get the car ready, and others get out the picnic hamper. Once the picnic goal has been accepted, coordination can come simply as a result of the thinking and action of each individual as he sees how his effort can be coordinated with that of others. Business enterprise is constantly using goals both to stimulate and to coordinate production and sales. We will come back later to the coordinating role of common goals.

For our present analysis, what is important is that there are at least four ways in which the action of individuals can be coordinated to a greater or lesser degree, and, in any concrete situation, coordination may involve two or more of these different methods. I believe that economic theory must take account of all four.

With this background, let us consider the various areas of economic theory and the direction in which they are developing or should develop because of the facts of collective capitalism. For this purpose I will distinguish between the following four major areas of economic theory: the theory of employment; the theory of the firm; the theory of allocation; and the theory of economic planning.

Employment Theory

The term *employment theory* is relatively new, but classical theory dealt with the problem of underutilization of resources under the heading of Say's law and in the equilibrium equations of Walras. According to both, the only condition of equilibrium in an atomistic economy is one of full use of resources. As Mill pointed out, according to classical theory, general overproduction was impossible—except, of course, temporary overproduction, which would quickly correct itself.

Actual events—the long American depression of the 1890's, Britain's long depression in the 1920's, the world-wide depression of the 1930's, and the long history of business fluctuations—finally broke the hold of Say's law and the belief in a self-correcting mechanism that would maintain reasonably full employment. Keynes came forward with a new theory of employment which he believed would explain the possibility of equilibrium at less than full employment in a competitive and flexible-price economy (*2*). For many years this theory found wide acceptance and helped to make theoretically respectable the rejection of Say's law. But in spite of the brilliance of Keynes' analysis, it rested on an assumption that is no longer generally accepted by economists—the assumption that the only way a change in the real stock of money could affect the level of demand and employment is through changes in the level of interest rates. I cannot go into detail here. It is sufficient to say that the statistical evidence does not support Keynes' assumption. Keynes has not supplied an explanation of unemployment for an economy of flexible prices and wage rates. For such an atomistic economy, the only condition of equilibrium would appear to be one of full employment; Say's law would still seem to hold for an atomistic economy.

But our present-day economy is not an economy of flexible prices and wage rates. The factory system and the modern corporation have brought changes which must be taken into the basic assumptions of theory. Labor is not a commodity, and wage rates are not flexible but a form of administered prices. In addition, administration of enterprise has extended into the goods market, and we also have administered prices for goods. When economic theory is rebuilt on the basis of administered prices and administered wage rates, I believe the inapplicability of Say's law and the Walrasian full-employment equilibrium will be obvious.

First let us consider wage rates. Classical theory had no difficulty picturing a commodity market for wheat or oranges with suppliers and demanders brought into adjustment by price. But have you ever run across a theoretical description of a market for labor in which the wage rate equates the demand and supply of labor? I never have, and I have never been able to envisage such a market. Would each worker come into the market each day and offer a basket full of "labor," and would employers "buy" a fresh lot of labor each day? This just does not make sense. A worker cannot sell his labor apart from himself; an enterprise cannot use labor apart from the persons who constitute it. And an essential part of the value of "labor" to an enterprise is the familiarity of the persons constituting "labor" with the equipment or affairs of the enterprise employing them. This means that a free market and flexible prices for labor are not feasible if big factory or corporate enterprise is to be efficient.

In actual fact, as I have said, wage rates are a form of "administered price." Before labor became organized, the typical procedure for establishing wage rates was administrative. In starting up a factory, the manager decided on what wage rates he would pay for each type of work and sent out word that jobs were available. If the supply of job seekers at those wage rates was larger than the number he wanted to hire, he would turn some away. If the supply was not as large as he wanted, he would send word farther afield, or perhaps he would send out recruiting agents to bring in workers. Thus the wage rates set by the manager would equate supply and demand only by chance. In most cases, either demand or supply would be in excess. And, what is most important for employment theory, the fact of a discrepancy between the supply and demand for labor would not lead the manager to alter his wage rates unless the discrepancy was considerable. Similarly, once a factory was in operation, if the manager needed fewer workers, he would lay off a part of his labor force. But he was unlikely to reduce his schedule of wage rates unless there was a very large increase in unemployment or unless his own firm was being seriously squeezed by competition. Thus, under the factory system, and even without labor organization, wage rates were administered and tended to be relatively inflexible, seldom closely equating the supply and demand for labor.

Whether or not the organization of labor has increased the inflexibility of wage rates is not clear. During the great depression of the early 1930's, wage rates dropped more in the clothing trades in which labor organization was strong than they did in such durable-goods industries as automobiles and electric equipment where unemployment was greater, labor was weak, and wage rates were administered by the corporate management. On the other hand, negotiated wage contracts certainly limit the power of management to change wage rates for periods of time. For present purposes it is immaterial whether the organization of labor increases the inflexibility of wage rates or simply confirms a behavior which management would have adopted in any case. What is important is that the factory system and the corporate system involve wage rates which do not behave like the classical commodity prices.

Administration of prices has also come to be a dominant characteristic of our factory and corporate economy (*3*). A company will set its price for a product and hold it constant for a period of time, selling whatever amount is demanded at the administered price. Demand at the administered price may be in excess of supply, as was recently the case with steel. Or demand may be less than the company is willing to supply at the administered price. As a result, an administered price will equate supply and demand only by chance, while an excess of supply or demand of considerable magnitude may develop without resulting in a revision of an administered price.

The classical theorists were familiar with administered prices, but, so far as I know, administered prices were never introduced as a basic assumption in classical economic theory. Their effect was treated as a matter of "friction" which slowed up but did not prevent the process of automatic adjustment. But today a large proportion of all labor and commodity transactions in this country take place at administered prices. Certainly most retail distribution, including a large part of food distribution, is at administered prices. So are most manufactured products and most of the services. Only in farm products and raw materials is the classical market price the general rule, and even here there are many exceptions. Thus, the factory and corporate systems provide us with administered prices, as well as administered wage rates, both of which lie outside of classical theory.

Once one introduces administered prices and wage rates as basic assumptions in employment theory, it is not difficult to explain equilibrium at less than full employment. Keynes did this, not as a theory, but as a device of exposition. When he analyzed the effect on employment of changes in the propensities to consume and invest, he first assumed that prices and wage rates were fixed. This was only a device to make it easier to follow his analysis, and he has made it clear that his conclusions on employment did not depend on this temporary assumption. Yet perhaps his greatest claim to fame will be this inadvertent introduction of a formulation of equilibrium with fixed prices and wage rates.

Of course, administered prices and wage rates are subject to change, and the new theory of employment must take account of the successive readjustment of prices and wage rates as the discrepancy between supply and demand exceeds some threshold of administrative action. The theory must be concerned both with the magnitude of this discrepancy and with the magnitude of the price revision when it is made. What is immediately important is that, when administered prices and wage rates are assumed, it is easy to construct economic models which reach short-run equilibrium at less than full employment and in which automatic forces operate toward full employment so slowly that they are not important. Thus, in one plausible model which I constructed, the automatic forces would restore full employment only after an infinite regression in time.

Here, then, is a major reconstruction of economic theory required by the actual characteristics of our economy. Fortunately, our practice in seeking to maintain full employment has run ahead of dependable theory. But a dependable theory of employment could greatly clarify the essential role of government and greatly increase the efficiency of practice in this field.

The problem here is to develop a statement of short-run economic equilibrium on the assumptions that some prices are of the classical type and that some are administered. We have the Walrasian formulation of equilibrium for an economy of perfectly flexible prices. We have the Keynesian formulation with its ambiguity about price, but it is capable of stating an equilibrium with prices fixed. What we need is a Walrasian-like formulation which will state the condition of equilibrium if some prices are administered and some prices are flexible, and indicate how changes in the equilibrium-determining factors will alter the equilibrium result.

Theory of the Firm

A second area of economic theory which needs reconstruction because of the modern corporation is the theory of the firm. This presents a many-issued problem, one that is at the heart of economic theory, since assumptions about the behavior of the firm enter into all other areas of economic theory.

Classical economics has given us a highly elaborated theory of the behavior of a firm—and here I include not only the classical line through Marshall but also the somewhat arid analyses of Chamberlin and Robinson (*4*). This theory is concerned with the firm as a buyer, combiner or producer, and seller of goods. And because labor is treated as a commodity, it applies primarily to an atomistic economy. The theory itself starts with the assumption that the entrepreneur is seeking to maximize his profit and works out the different patterns of behavior which would maximize profit under various known conditions.

This theory, when it is applied to imperfect competition, has always given me a good deal of trouble, even as applied to an atomistic economy. But let us assume that the classical theory of the firm does apply to the small entrepreneur in an atomistic economy or is so modified that it does apply and ask what modifications are needed to make it fit the corporate firms of collective capitalism.

The first change is implicit in our dis-

cussion of employment theory: the new theory of the enterprise must account for the well-nigh universal presence of administered prices and wage rates and their respective behavior. There is nothing in the classical theory of the profit-maximizing firm which would lead one to expect administered prices or administered wage rates.

A second change was pointed out by Adolf Berle and me in our book, *The Modern Corporation and Private Property* (*5*), in which we indicated how the separation of ownership and control in most of our big corporations undercuts the function of profits to owners as a stimulus to more efficient operation of the enterprise. Consider first the profits going to those stockholders who do not in fact control the enterprise or make policy. Such profits cannot act as an incentive to better operation of the enterprise. And if, instead, profits over and above the amount necessary to induce investment were to go to the controlling management so they would induce more efficient operations, as profit theory would require, the courts would find this illegal, because the profits "belong" to the stockholders.

On the other hand, how much do profits from ownership act as a stimulus to those in control of a big corporation whose stock is widely dispersed? It is often said that, even though a controlling group may own only a small proportion of a company's stock, their ownership interest and the incentives arising from it can still be large because of the size of the company. Let us look at this for a minute. Consider, for example, a memorandum recently circulated by the Atchison, Topeka, and Santa Fe Railway Company giving the stockholdings of the directors of the company who are, in effect, in control of that corporation. In combination, the directors hold one-tenth of 1 percent of the outstanding stock. The average stockholding per director has a current market value of approximately $50,000, and the largest holding by a director is just under $200,000. These are sizable amounts of investment. But do they really supply a significant inducement to strive vigorously to increase the company's profit? Suppose that, by more vigorous direction, the company could be made to yield 20 percent higher profits. Assuming that this would mean a 20 percent higher dividend, the average director would get $600 more in dividends, while the director with the largest stockholding would get 4 times this amount. And since most of the directors, if not all, are already paying income taxes at the more robust rates, only a part of the $600 would be a reward. My own belief is that the directors of such a well-run railroad as the Santa Fe try to run it well for the same reasons that the trustees of a great university seek to run the university well. In the case of the Santa Fe, profits are a symbol of successful operations, but I question how far the receipt of profits by the controlling directors *through their ownership* is a dominant stimulus to efficient operation.

I am not here suggesting that profits do not play an important role in big corporate enterprise. I am suggesting that their role may be quite different from that attributed to profits in the representative small firm of classical theory. As a minimum, we can say that profits cannot perform their traditional role where ownership and control are separated, for this traditional role depended on the assumption that ownership and control were combined. We should start fresh and ask just what are the motivations of top corporate management—to increase their personal incomes, to serve the stockholders, to expand management's power, to foster the status of the corporate collective, to serve the public interest? Clearly, a new theory of the firm to apply to the corporate collective must start with an analysis of motivation in the big business bureaucracies. Such an analysis must be based on actual observation. This will not be easy, because motivation is itself elusive. Perhaps such investigations will require the joint action of economist, political scientist, psychologist, and anthropologist. Until such studies are made, our basis for assuming motivation is inadequate.

In the meantime, I offer the suggestion that a study of motivation in the top management of a great university would throw more light on the motivation of top corporate management than any amount of study of small private enterprises. Like a university, the great corporate collective is a "going concern" with its own momentum and its own internal drives and internal conflicts. Literature is beginning to reflect this in such books and plays as *Executive Suite* and *The Solid Gold Cadillac*. How far is the task of top management in the corporation that of generating and sustaining group thinking and group decision-making? And what factors actually enter into top management decisions?

There are also problems of motivation in the lesser ranks of management. Are the pressures for conformity and compromise in the group activities of management reducing initiative and enterprise, either by suppressing it or by selecting away from it? Are the great corporations creating a new "economic man"—the "organization man"—with new characteristics which the economist will have to understand, analyze, and take into account? (*6*). And can the "organization man" be adequate to fill the shoes of top management?

The bureaucratization of industry requires still another extension of the theory of the firm—the study of the bureaucracy itself. How are the great corporations actually run? How are the activities of 100,000 persons coordinated within a single enterprise? What kind of organization makes for effective use of resources; what kind, for wasteful use? With so much of the coordination of individual activity brought about through administrative action within single units, how does this affect the use of resources in the satisfying of wants? In some degree this aspect of enterprise theory must deal with the same problems of administration as those dealt with by political theory in its analysis of government bureaucracy, but in other respects, particularly in its focus on the impact of administration on the use of resources, this will be a new kind of allocation theory in which the unseen hand of Adam Smith is replaced by the visible hand of business bureaucracy.

The reconstituted theory of the firm will also have to take account of corporate politics as well as corporate economics. The modern corporation is more than a legal framework of enterprise. It is an institution for interrelating the interests of security holders, workers, consumers, and management. As such, it is a focus for conflicting, as well as common, interests, and it is the focus of power conflicts. Just where in these power conflicts economics leaves off and political science begins is not at all clear. Perhaps what we need is a new joint science which gives new content to the old term *political economy* and applies it to the politicoeconomic formation of policy in the great corporate enterprises as well as in government.

Finally, the theory of the corporate firm will have to consider the public responsibility of corporate management arising from size and from the separation of control from consumer, worker, and owner alike. In our book on the modern corporation, Berle and I (*5*) suggested that, if the controlling management of the big dispersely owned corporations adopted the role of arbiter between stockholders, workers, and consumers, the courts might accept such a role. Certainly there is considerable evidence that the larger corporations are accepting some degree of social responsibility as a step toward their own long-run status and survival. The theory of the collective firm must therefore consider under what conditions, if any, an enterprise can operate to serve the public interest without itself assuming any social responsibility; and also under what conditions an enterprise is so large or so relates investors, workers, and consumers that it must take into account, or be made to take into account, considera-

tions of social interest as well as those of corporate profits.

When we have an adequate theory of the collective corporate firm, we will be able to picture an economic model of big corporate enterprise. Such a theory, combined with adequate theories of the firm for an atomistic and for a factory economy, should give us the basis for understanding most firm behavior in our actual complex economy.

Allocation Theory

The third great branch of economics I propose to discuss is allocation theory. Classical allocation theory rests on or includes the traditional theory of the firm and is concerned with the process by which scarce resources are allocated to different uses. It starts with the assumption of full employment and deals with the way in which prices and the market mechanism operate to direct resources into the production and distribution of the goods most in demand. Marshall's *Principles* represents the greatest formulation of this theory (7). It has been much elaborated since Marshall's time, but a great deal of the elaboration is to be found, at least in embryo, in Marshall's footnotes.

Certain basic assumptions of this theory are clear. Besides the assumption of full employment, the theory postulates Marshall's representative firm with ownership and control combined in a single owner or partnership. It treats labor as a commodity. And it assumes flexible prices which adjust to equate supply and demand. With these postulates, Marshall purports to show that, in general, prices (including wage rates) will so adjust that price and marginal cost will tend to be approximately equal, resources will tend to be used in the most productive manner, and the rewards to the factors of production will tend to be close to their respective marginal contributions to production. This theory is of great importance today, because a great deal of private and public policy is built upon it, either consciously or unconsciously.

Now I do not wish to raise here the question of whether the conclusions of this theory logically flow from its postulates. The significant question is whether these same conclusions would flow if we postulated, not Marshall's representative firm, but the modern corporation with its vast size and the separation of ownership and control; if we postulated, not labor as a commodity, but labor as a group of human beings; if we postulated, not flexible prices which equate supply and demand, but administered prices under which supply and demand can be different. As far as I know, there is no one who has developed a coherent theory which rests on such modern postulates and develops their implications.

I have not done much work in the field of allocation theory, having been primarily concerned with employment theory, but I can at least lay down some questions which should challenge attention.

Let us consider an economic model in which all economic production is carried on by 400 huge corporations. Let us also say that, at the outset, while each company produces many products, there are only four companies producing each particular commodity and that each has its own particular brands with their own characteristics; that labor, unlike a commodity, has created labor unions, and that wage rates are made by collective bargaining between unions and individual companies; and that the individual companies offer and promote the sales of their products at administered prices which are seldom changed except as quite large changes in costs or demand occur; and finally, that we start with full employment. How would such an economy run?

You will notice that I have excluded price wars by assumption. With only four producers of a commodity and with a considerable degree of product differentiation, competition can express itself in greater advertising expenditures, increased product differentiation, product improvement, and other means which seek to take business away from competitors or to expand the market. But the knowledge that a price cut will be met or surpassed by a competitor will inhibit price cuts, except to adjust to a considerable change in cost or demand.

I would also raise the question whether even a major change in demand would affect price. At a recent meeting of businessmen and economists, the head of one of our big retail and manufacturing enterprises argued that demand had no influence on prices and challenged the economists present to show how an increase in the demand for the products of his company would lead to his charging higher prices. In his thinking, prices were determined by costs and probably, for his particular firm, he was essentially right. Of course, it was easy to suggest that many raw materials have flexible prices which are sensitive to changes in demand and that, when the demand for his products increased, he increased orders and thereby increased the demand for raw materials somewhere back along the line and that this ultimately raised his costs. But, suppose that raw materials were produced only by a few companies and these companies also operated with inflexible, administered prices. Under what conditions would changes in demand have an effect on prices? How large a change in demand would be necessary to trigger a change in price? And what relation could be expected between marginal cost and price?

Then consider the question of profits or rate of return on capital. Traditional theory suggests that, with only four producers and no price wars, the rate of return on captital would tend to be abnormally high in relation, say, to interest rates or to the current costs of capital. Is this in fact true? What would place a roof on excessive earnings? Would strong labor unions prevent too high rates of earnings? Or would labor and capital gang up on the consumer? And if this happened equally for *all* industries, would it make any difference, since the high money prices could be met out of high money incomes? Would competitive advertising and promotion so increase selling costs as to absorb excessive profits, keeping costs and prices in line, not by reducing prices but by increasing costs? Would the threat of new entrants into a given market keep profits in bounds? And if profits were not kept in line, who would benefit from high rates of earnings, stockholders who do not control the enterprise or management that does? Also, would it be possible to maintain full employment in such an economy and avoid inflation?

An even more fundamental question is whether, in our economic model of a few great collectives, resources would be well allocated. Here we have to deal not only with the determinants of relative prices which help to guide the flow of resources into different uses but also with the direction of resources within the great collectives. It is often said that consumers direct the use of resources by what they purchase. Yet how great is consumer choice? If you want to buy a new American car this year you have, as far as I can see, very little real choice. What you are offered is a longer, heavier car with fins. I am reminded of a recent cartoon in which two men are looking down at the rear of a new high-finned car and one says to the other, "You don't like fins and I don't like fins. What would happen to the American economy if nobody liked fins?" In some ways, our big American producers are the most efficient in the world. But if finned cars are a temporary matter and are not really wanted by the people who will have to buy them secondhand, the resale value of finned cars will be low and the reduction will reflect inefficiency in the use of resources which could offset a good deal of efficiency in production. The problem of the allocation of resources through corporate enterprise is both a matter of efficiency in production

and importantly a matter of what is produced. A consumer veto over wasteful use of resources is by no means the same as consumer control over their use.

Here I have raised questions about how allocation in an economy made up of big enterprises could be expected to take place. I could go a lot further in asking specific questions. But what is important here is that the questions are of a sort which cannot be answered by any amount of study of Marshallian theory, including Marshall's footnotes. Clearly a new, coherent body of allocation theory is needed if we are to understand our actual economy and make wise decisions in such matters as antitrust policy, government regulation, and economic planning. Such a new, coherent body of theory would derive many of its parts from older theory. Other pieces for such a theory which cannot be derived from Marshallian theory are already developed or in the process of development. But, as far as I am aware, no coherent theory has been produced which would effectively describe allocation in a model economy of collective capitalism or for our actual economy, which is so largely composed of big collective corporate enterprises.

I could go on into other fields of economic theory and point to other changes in theory required by the factory system and collective capitalism: the inapplicability of the classical mechanism of international trade adjustment, the irrelevance of a wage theory which relates wage rates to the marginal product of labor, and the minor importance of a growth theory which builds on private individual invention. But to go into them would take too much space.

There is, however, one major field of theory which has been added by the development of collective capitalism and which was quite absent from traditional theory—the theory of economic planning.

Need for a Theory of Economic Planning

There has been a great deal of confusion about economic planning—particularly, its relation to dictatorship. This is understandable, since economic planning has been most highly developed in the U.S.S.R. and is directly tied to government operation of industry. But economic planning itself can be an important tool in a democracy. It can facilitate more effective use of resources without dictating those uses.

Consider for a moment our recent transition from a war to a postwar economy. For the first time in a long history of business fluctuations, a postwar depression was avoided. How did it happen that demand and employment were sustained after the war? Partly it was the result of the pent-up demand and fiscal expansion which have always accompanied major wars. But I believe it was partly the result of economic planning (in which the Committee for Economic Development played an important role), as a result of which both government and industry were already prepared to make a quick shift from war to civilian production, and the potential goals of production were set for a full-employment economy. How this was done is a long story, but that it was done and that it did contribute to the prevention of a postwar depression, I am certain.

We find economic planning being encouraged by businessmen in connection with our foreign economic aid. Thus, one well-known business leader recently suggested that, in providing economic aid to the less-developed countries, we should require that any country to be aided should prepare a well-worked-out plan for economic development.

And, of course, we are undertaking a form of economic planning in our governmental agencies concerned with the maintenance of full employment, particularly in the Council of Economic Advisers and the Federal Reserve Board.

We also need to consider the potentials of economic planning in bringing about a better use of resources. I believe that, when an adequate theory of allocation is worked out for collective capitalism, it will show a very considerable degree of indeterminacy in the allocation of resources insofar as purely economic forces are concerned and that, if we are to have a high degree of effectiveness in the use of resources and avoid the pressure for government direction, we must have a clearer picture of what seems likely to constitute effective use of resources as a background against which private, corporate, and government decisions can be made. This would be economic planning without compulsion.

Conclusion

Finally, I want to express my enthusiasm for collective capitalism. I believe that it is, to a major extent, responsible for the high levels of living which we enjoy in this country. I believe that we are still some way from understanding how it really works and what its imperatives are. We have started meeting some of these imperatives in our social security programs, in government action to clear the way for the organization of labor, and in our acceptance of government responsibility for full employment. Our problem now is to understand its operation so well that we can make it provide not only full employment and high productive efficiency but effective use of resources, equitable distribution of income, freedom to the individual to develop his resources, and the continued growth which is a potential of collective capitalism. I do not believe that this can be achieved if we base our policies on economic theories built on the postulates of Marshall's representative firm, flexible prices, and labor treated as a commodity.

As I said at the outset, I believe that our position today is very much like that of the physical scientists 50 years ago when the reality and importance of the quantum had been accepted but was not a postulate of current theories. We need an economic Niels Bohr, a de Broglie, a Heisenberg, and a Dirac to reconstruct or revolutionize economic theory as these men revolutionized physical theory. Such new theory seems to me likely to be quite different from classical theory, because so many of its underlying parts would be new. It would have to take full account of the implications of administered prices, the new status of profits, the concept of countervailing powers. I believe that such a theory would indicate the great economic and social advantages of the great corporate collectives but that it would also bring out the ways in which the economic results fall far short of being satisfactory and suggest ways in which improvement could be made. But, even more important, I believe that it would greatly clarify the character of the responsibilities which the managers of our great collectives have assumed and are only now beginning to be aware of and would provide an improved basis for public policy under our system of collective capitalism.

References and Notes

1. D. H. Robertson, *Banking Policy and the Price Level* (King, London, 1926).
2. J. M. Keynes, *The General Theory of Employment, Interest, and Money* (Harcourt, Brace, New York, 1936).
3. *The Structure of the American Economy* (National Resources Committee, Washington, D.C., 1939); see also E. G. Nourse, *Price Making in a Democracy* (Brookings Institution, Washington, D.C., 1944).
4. E. Chamberlin, *The Theory of Monopolistic Competition* (Harvard Univ. Press, Cambridge, Mass., 1932); J. Robinson, *Economics of Imperfect Competition* (Macmillan, London, 1936).
5. A. A. Berle, Jr., and G. C. Means, *The Modern Corporation and Private Property* (Macmillan, New York, 1933).
6. W. H. Whyte, Jr., *The Organization Man* (Simon and Schuster, New York, 1956).
7. A. Marshall, *Principles of Economics* (Macmillan, London, ed. 8, 1920).

J. G. Hamilton, Medical Physicist and Physician

Joseph Gilbert Hamilton, professor of medical physics and director of the William H. Crocker Radiation Laboratory, University of California, Berkeley, and professor of experimental medicine and radiology at the University of California School of Medicine, San Francisco, succumbed to leukemia on 18 February at the age of 49. Few persons have contributed more to the development of current concepts in the field of radionuclide metabolism in experimental animals and in man.

Hamilton obtained his elementary education in the public schools of Santa Barbara, California, and did his undergraduate and premedical work at the University of California at Berkeley. He obtained his M.D. degree in 1936. His interest in the medical aspects of radioactivity began while he was still a house-officer at the University of California School of Medicine. It was during this period that cyclotron-produced radioisotopes from the Radiation Laboratory were becoming available in amounts sufficient for clinical investigation.

In early 1936, Hamilton made a first study of the therapeutic and metabolic properties of radiosodium in man. Publications on the diagnostic and therapeutic uses of radioiodine in the study of thyroid disorders in human beings were followed by studies of the comparative metabolism, in experimental animals, of radioiodine and the newly discovered radioelement, astatine. The observation that astatine, like iodine, is selectively accumulated by the thyroid gland was made by Hamilton during the same week that the chemical and physical identification of astatine as a halogen was being established by Corson, MacKenzie, and Segrè. Hamilton's lifelong interest in the metabolism of radionuclides appears to have been firmly established during this period, and he became more actively associated with the medical research program of the Radiation Laboratory.

In 1942 Hamilton was made assistant professor of medicine and radiology and supervisor of the Crocker Laboratory 60-inch cyclotron. During World War II, he directed, as part of the medical and health program of the Plutonium Project, an extensive investigation of the metabolism, in experimental animals, of the principal fission products and fissionable elements. He supervised not only the biological part of this program, including the development of new techniques of radioautography, but also the production and isolation of a large number of radioelements in the carrier-free form and the operation and maintenance of the 60-inch cyclotron for a number of chemistry and physics programs related to the Plutonium Project. His broad range of scientific interests, his enthusiasm, and his energetic approach to experimental problems contributed greatly to the successful continuation of these studies.

Research on radionuclide metabolism by the Crocker Laboratory group continued under Hamilton's direction during the postwar years as part of the Radiation Laboratory program supported by the U.S. Atomic Energy Commission. In 1947 he was appointed associate professor and, in 1948, was named director of the Crocker Radiation Laboratory. Full professorship followed in 1950. During his 25-year tenure he was coauthor of more than 50 papers on biological and medical aspects of radioactivity. Indicative of his contributions in this field is the fact that the recent report of the International Commission on Radiological Protection shows that more than half of the estimated values of permissible dose for internal radiations are based on studies carried out at the Crocker Laboratory.

Hamilton was keenly aware of his responsibilities in the scientific community. He gladly devoted a large part of his time to his students, both undergraduate and graduate, and he made great effort to encourage initiative and independent thought.

He showed a strong sense of continuing loyalty to his students and associates. Although active in the organizational activities of the university and the scientific societies, he also served on numerous committees of the National Research Council, the U.S. Public Health Service, and the Atomic Energy Commission. He had been a medical consultant to the Division of Biology and Medicine of the Atomic Energy Commission since 1946.

During the past year, although aware of the serious nature of his illness, he attempted to retain an active interest in the work of the laboratory, and he was sustained in this effort by the quiet courage of his wife, Leah. Hamilton's contributions to radiation research will continue to be of great importance in the study of radiation-induced diseases and will be a memorial to him and a reminder to those who knew him.

ERNEST O. LAWRENCE
WARREN M. GARRISON
Radiation Laboratory,
University of California, Berkeley

News of Science

International Atomic Energy Agency

Formal requirements for the establishment of the International Atomic Energy Agency were met on 29 July when the United Kingdom, the United States, France, Canada, Australia, and Brazil deposited ratification papers. Twenty other nations, including the Soviet Union, had previously ratified the agency's statute.

The first general conference of the agency will open in Vienna, Austria, on 1 Oct. This conference will bring the agency into operation by completing the selection of the board of governors. The two principal organs of the agency, the general conference and the board of governors, will decide on the budget, staff structure, and program of the agency as well as on its relationship with the United Nations and with other international organizations. They will also appoint a director general of the agency and determine its permanent seat, for which Vienna was recommended by the conference on the statute.

The Preparatory Commission of the agency, composed of representatives of 18 countries, which has been meeting in New York since October 1956, has prepared recommendations on the substantive issues to be considered by the first general conference and the first board of governors.

Although the United States has ratified the agreement, legislation authorizing monies for, and the appointment of, a representative to, the agency have been discussed extensively in committee, where an amendment proposed by Senator John W. Bricker of Ohio was considered and reconsidered. This amendment specified that the President must obtain the consent of Congress each time he wishes to make nuclear materials available to the agency. The amendment was adopted by the Joint Congressional Committee on 19 July and readopted by a smaller majority on 30 July. However, both Republican and Democratic members of the committee teamed up against it on the House floor, and on 8 Aug. the House voted to strike the restriction out by a vote of 298 to 99.

Oregon Museum of Science and Industry

Tomorrow, on a site in the Portland (Ore.) Zoological Gardens, an effort will be made to erect, in one day, the walls of a new building to house the Oregon Museum of Science and Industry. Several hundred members of the Unit Masonry Association will attempt to lay 100,000 units of masonry, including brick and block, in the "barn-raising bee." Members of Bricklayers Local No. 1, AFL-CIO, are contributing their time; the Mason Contractors Association is donating time and equipment; and the manufacturing and distributing members of the Unit Masonry Association are contributing material and equipment, in some cases at no cost to the museum.

Construction of the museum building follows a campaign, conducted for the past several months as "project science," to provide a new museum of science and industry for the state of Oregon.

Smoking and Cancer in Britain

The following excerpts are drawn from the British Medical Research Council's statement on "Tobacco smoking and cancer of the lung":

"In their annual report for 1948–50 the Council drew attention to the very great increase that had taken place in the death-rate from lung cancer over the previous twenty-five years. Since that time the death-rate has continued to rise, and in 1955 it reached a level more than double that recorded only ten years earlier (388 deaths per million of the population in 1955 compared with 188 in 1945). Among males the disease is now responsible for approximately 1 in 18 of all deaths. Although the death-rate for females is still comparatively low, it also has shown a considerable increase in recent years and the disease is now responsible for 1 in 103 of all female deaths.

"Three comments may be made on these figures. In the first place, the trend over the last few years indicates that the incidence has not yet reached its peak. Secondly, the figures are not to be explained as a mere reflection of the introduction and increasing use of improved methods of diagnosis but must be accepted as representing, in the main, a real rise in the incidence of the disease, to an extent which has occurred with no other form of cancer. Thirdly, only a small part of the rise can be attributed to the larger numbers of older persons now living in the population; in the last ten years the lung-cancer death-rates among both men and women have risen at all ages from early middle-life onwards. . . .

"From the nature of the disease attention has focused on two main environmental factors: (1) the smoking of tobacco, and (2) atmospheric pollution—whether from homes, factories, or the internal combustion engine. . . .

"The evidence that heavy and prolonged smoking of tobacco, particularly in the form of cigarettes, is associated with an increased risk of lung cancer is not based on the observation that the substantial increase in the national mortality followed an increase in the national consumption of cigarettes. It is derived from two types of special inquiry. In the first, patients with lung cancer have been interviewed and their previous histories in relation to smoking and other factors that might be relevant have been compared with those similarly obtained from patients without lung cancer. The results of nineteen such inquiries (in this country, the U.S.A., Finland, Germany, Holland, Norway, and Switzerland) have been published. They agree in showing more smokers and fewer non-smokers among the patients with lung cancer, and a steadily rising mortality as the amount of smoking increases. In the second type of inquiry, information has been obtained about the smoking habits of each member of a defined group in the population and the causes of the deaths occurring subsequently in the group have been ascertained. There have been two such investigations, one in the U.S.A. covering 190,000 men aged 50–69, and the other in this country covering over 40,000 men and women whose names appeared on the Medical Register of 1951. In both, the results have been essentially the same. The investigation in this country, which has now been in progress for more than five years, has shown with regard to lung cancer in men: (1) A higher mortality in smokers than in non-smokers. (2) A higher mortality in heavy smokers than in light smokers. (3) A higher mortality in cigarette smokers than in pipe smokers. (4) A higher mortality in those who continued to smoke than in those who gave it up. It follows that the highest mortalities were found among men who were continuing to smoke cigarettes, heavy smokers in this group having a death-

rate nearly 40 times the rate among non-smokers. Although no precise calculation can be made of the proportion of life-long heavy cigarette smokers who will die of lung cancer, the evidence suggests that, at current death-rates, it is likely to be of the order of 1 in 8, whereas the corresponding figure for non-smokers would be of the order of 1 in 300. The observation on the effect of giving up smoking is particularly important, since it indicates that men who cease to smoke, even in their early forties, may reduce their likelihood of developing the disease by at least one half. . . .

"Knowledge of the causation of lung cancer is still incomplete. Many factors other than tobacco smoking are undoubtedly capable of producing the disease; for example, at least five industrial causes have been recognized. Nevertheless, the evidence for an association between lung cancer and tobacco smoking has been steadily mounting throughout the past eight years and it is significant that, during the whole of this period, the most critical examination has failed to invalidate the main conclusions drawn from it. . . . The epidemiological evidence is now extensive and very detailed, and it follows a classical pattern upon which many advances in preventive medicine have been made in the past. . . ."

PIRATE

The Pacific Science Board of the National Academy of Sciences–National Research Council is sponsoring a 3-year study of the biology and ecology of rats on Pacific islands. Rats occur on most of these islands, where they play a dominant, and often disruptive, part in the ecology of the biotic community. The scientific literature indicates, however, that no fundamental research on island rat populations has been carried out in recent years. The few local studies of rat biology have been of brief duration and restricted in scope.

Field work was started in the summer of 1955 at Ponape in the U.S. Trust Territory, a tropical island of 130 square miles that has mountains rising 2500 feet and a population of about 6000. The civil administrator has made available the facilities of the Agricultural Station as well as housing and other forms of assistance.

The investigation, known as the PIRATE (Pacific Island Rat Ecology) Project, is designed to gather data on the normal activities of rats on both high islands and atolls. The common local species are the black rat (*Rattus rattus*) and the Polynesian rat (*Rattus exulans*), while about the buildings there are Norway rat (*Rattus norvegicus*) and the house mouse (*Mus musculus*).

The principal investigator of this project is Tracy I. Storer of the University of California at Davis, who is assisted by ten project consultants. The field research team, which has a changing membership, includes Joe T. Marshall, Jr., University of Arizona (1955–56); William B. Jackson, formerly with the U.S. Public Health Service (1955–57); Robert L. Strecker of Miami University (1956–58); and Kyle R. Barbehenn, formerly with the Army Chemical Center (1957–58).

The PIRATE program is made possible as a result of generous assistance from the Administration of the Trust Territory of the Pacific Islands, logistic support from the Office of Naval Research, and financial assistance from the National Science Foundation and National Institutes of Health. Storer would appreciate receiving any information on Pacific Island rats that might be helpful to the research team or that might be evaluated in the preparation of the final report of the project.

National Foundation for Infantile Paralysis Fellowships

The National Foundation for Infantile Paralysis offers postdoctoral fellowships in research, academic medicine, or the clinical fields of psychiatry, rehabilitation, orthopedics, the management of poliomyelitis, and preventive medicine and also in the medical associate fields of social science, health education, physical therapy teaching, and occupational therapy teaching.

Financial support of the fellow varies according to his previous education, professional experience, marital status, and number of dependents. Compensation to the institution is arranged according to the program undertaken. For a full academic program, tuition and fees are allowed; for other programs, a sum not to exceed $1250 per year (includes tuition) is provided.

All awards are made upon recommendation of the appropriate National Foundation Fellowship Committee. U.S. citizenship is required, but those who have filed a petition for naturalization will be considered. Partial fellowships are available for qualified veterans to supplement G.I. educational benefits.

The National Foundation has authorized the expenditure of $26,500,000 since 1938 for scholarships and fellowships, and for aid to educational institutions, professional organizations, and related activities. Current deadlines for applications in the medical and medical associate fields are *1 Sept.* and *1 Dec.* for consideration in November and February, respectively. For further information write to: Division of Professional Education, National Foundation for Infantile Paralysis, 301 E. 42 St., New York 17, N.Y.

Los Alamos Group on Nuclear Tests

The Los Alamos Chapter of the Federation of American Scientists, which has about 50 members who are employed at the Los Alamos Scientific Laboratory, has released a statement entitled "Putting nuclear weapons testing in perspective." The statement expresses concern about the arguments presented to President Eisenhower recently by E. O. Lawrence, Edward Teller, and Mark Mills in favor of continuation of nuclear tests to develop "cleaner" bombs. In the company of Atomic Energy Commission Chairman Lewis L. Strauss, the three physicists from the University of California Radiation Laboratory are reported to have said to the President: "Give us four or five years to test each step of our development and we will produce an absolutely clean bomb."

The FAS Los Alamos group says:

"We are encouraged by some recent improvements in the prospects for agreement in the London disarmament talks. At the same time we regret that recent highly publicized views of Drs. Ernest O. Lawrence, Edward Teller, and Mark M. Mills were subject to interpretation as an oblique attack on initial forms of the U.S. disarmament proposals.

"The dominant concern of U.S. policy must be to seek out and to take all equitable steps in disarmament and in international relations which can be expected to diminish the risk of war. When placed in contrast with this objective, technical improvements in the means of waging war are insignificant. Therefore, it is urgent that the technical reasons recently publicized for continuing nuclear weapons tests be put in proper perspective. . . . The choice which faces us now is not so much between 'clean' and 'dirty' bombs, but rather between a world in which war and, therefore, nuclear bombing will occur, and a world in which we shall be free of their scourge.

"A secondary technical reason offered for continuing weapons testing is the hope that such testing may contribute to the development of peacetime uses of atomic energy. To the extent that there is a basis for this hope, we stress that the appropriate auspices for such a program would be provided by the inspection and supervision of a U.N. Commission, rather than by the competitive concealment of secret weapons programs. . . .

"We are reassured by President Eisenhower's firm statement that this country will not be deflected from its offers to ban, under appropriate conditions, the

testing and production of nuclear weapons, despite the technical reasons that have recently been advanced for continuing military programs for nuclear weapons testing. We share the President's conviction regarding the importance of the London disarmament negotiations as a means through which this country may move closer to a basis for security through world peace."

Financial Help for Type Culture Collections

The International Association of Microbiological Societies has at its disposal certain limited funds, which it receives from the International Union of Biological Sciences, for assisting the work of type culture collections of microorganisms. Curators of such collections who make their type cultures internationally available and require financial help for this purpose are invited to make application *immediately*, specifying their need, to the secretary of the IAMS, Prof. G. Penso, Istituto Superiore di Sanità, Viale Regina Elena, 299, Rome, Italy.

Heart Association Fellowships

The American Heart Association has announced that applications by research investigators for support of projects to be developed during the fiscal year beginning 1 July 1958 are now being accepted. Funds for association-supported research in the cardiovascular field are provided by public contributions to the Heart Fund. At least half of all funds received by the American Heart Association's national office are allocated to research.

The deadline for research fellowship applications and established investigatorships is *15 Sept.* Applications for grants-in-aid must be made by *1 Nov.* Further information and applications may be obtained from the medical director of the American Heart Association, 44 E. 23 St., New York 10, N.Y.

African Locust Peril

The 20-nation United Nations committee on desert locust control has warned against an approaching plague of locusts in Africa and the Middle East. An infestation comparable to the disastrous invasion of 25 years ago is expected.

Heavy crop damage has already been experienced in Libya and Tunisia. Extensive summer breeding of the insect is now under way in Equatorial Africa, and swarms are expected to escape to surrounding countries from widespread breeding grounds in central and southern Arabia. In the Somali peninsula, breeding of scattered local swarms has also been augmented by outside swarms, and further invasions are expected. The developments are described as a departure from the normal pattern of the locust cycle, with three generations of locusts and perhaps a fourth involved, as against the usual cycle of one or two generations.

Under the auspices of the Food and Agriculture Organization, the mobilization of men and equipment and a centralized system of locust control have been on an international basis since 1952, with offices in Saudi Arabia and Ethiopia. The committee has recommended establishment of a third center to coordinate the work in northern, northwest, and western Africa.

Fish Collection

The collection of type specimens of fishes described principally by William Beebe, director of the department of tropical research of the New York Zoological Society, and his staff has been donated to the United States National Museum and to Stanford University. The division of this collection was made on a geographic basis. The types of species described from Atlantic Ocean localities are now in the National Museum, those from the Pacific in the Natural History Museum, Stanford University. A detailed list of the type specimens of fishes resulting from Beebe's work and their present location is in preparation.

Team Work on Embryology

The Hubrecht Laboratory in Utrecht, Holland, organizes projects for international research teams every 2 years. The third team will meet in 1958 from 15 Mar. to 15 Sept. The general topic will be "A morphological and physiological analysis of regulative and nonregulative processes in the development of mosaic eggs of several terrestrial and fresh-water invertebrates." The general idea of international cooperation in science, as well as specific scientific aims, is the goal of these projects.

The team is open to postgraduates in biology and related sciences. It is particularly meant for young staff members who will be able to continue their work afterward. The size of the team will be limited to 10 participants; as many nations as possible will be represented. Either English, French, or German will be chosen as the communicating language, depending on the familiarity of the participants with these languages. The closing date for application is *15 Sept. 1957*. Those interested should write to the director of the Hubrecht Laboratory, Janskerhof 2, Utrecht, Holland, and include information about their scientific education and personal record and two letters of recommendation from well-known scientists.

Chymia

The publication of *Chymia*, an annual devoted to the history of chemistry, will be resumed in the spring of 1958 with volume 5. The publication is now sponsored jointly by the Edgar Fahs Smith Collection of the University of Pennsylvania and the Division of the History of Chemistry of the American Chemical Society. All papers will be published in English.

The editor-in-chief is Henry M. Leicester, College of Physicians and Surgeons, San Francisco, Calif., and all articles for publication should be submitted to him. The journal will be published by the University of Pennsylvania Press, 3436 Walnut St., Philadelphia 4, Pa.

New Journals

Dermatologia. Revista Mexicana. vol. 1, No. 1, July–Sept. 1956. Obdulia Rodrígues, Ed. Asociación Mexicana de Acción contra la Lepra, 1 Calle Dr. Garciadiego No. 21, México 7, D.F. Three times a year. $5.

Illinois Journal of Mathematics. vol. 1, No. 1, Mar. 1957. J. L. Doob *et al.*, Eds. University of Illinois, Urbana. Quarterly. $9 per vol. (four numbers).

Journal of Microbiology, Epidemiology, and Immunobiology (translated from the Russian). D. J. Bauer, scientific translation editor. Pergamon Institute, New York. Monthly. $50 per year.

Journal of Molecular Spectroscopy. vol. 1, No. 1, July 1957. Harald H. Nielsen, Ed. Academic Press, New York. Bimonthly. $10 per vol.

Microchemical Journal, vol. 1, issue 1, 1957. Nicholas D. Cheronis *et al.*, Eds. Interscience, New York. Semiannually. $9.60 per year.

Nuclear Instruments. On accelerators, instrumentation, and techniques in nuclear physics. vol. 1, No. 1, Jan. 1957. K. Siegbahn, Ed. North-Holland, Amsterdam. Bimonthly. $17 per vol.

Population Review. Asian demography. vol. 1, No. 1, Jan. 1957. Indian Institute for population Studies, Madras 20, Semiannually. R. 10.

Scopus. vol. 1, No. 2, May 1957. Hebrew University, Jerusalem.

SRI Journal. vol. 1, No. 1, Jan.–Mar. 1957. Charles A, Scarlott, Ed. Stanford Research Institute, Stanford, Calif. Quarterly. $4.

Tetrahedron. International journal of

organic chemistry. vol. 1, Nos. 1–2, Apr. 1957. H. Stephen, Ed. Pergamon Press, New York. $17 per vol. ($9.80 for subscribers certifying journal is for personal use only).

Thrust. On jet power development and utilization. vol. 1, No. 1, summer 1957. Fairchild Engine and Airplane Corporation, Deer Park, N.Y. Quarterly.

Research on Aging

Duke University has announced plans to establish a Regional Center for Research on Aging with the partial support of the U.S. Public Health Service. Overall work of the center will be directed toward the ultimate goals of slowing the aging process, promoting the health of elderly persons, and preventing or delaying the institutionalization of the aged. Workers in fields such as psychology, sociology, and economics, as well as medicine, will participate in this program.

The Duke University Council on Gerontology will serve as an "operational core" for the new center, which will be based administratively in the Duke University School of Medicine. Existing laboratories and other facilities in the medical school and Duke hospital will be used for the center's program.

The Public Health Service has awarded approximately $300,000 to support research during the first year. The award is the first grant in the service's new program to encourage the establishment of regional research centers in which many departments of a university and health agencies of a community will cooperate in the study of aging.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills recently introduced follows:

H J Res 404. Provide for recognition and endorsement of Second World Metallurgical Congress. Bolton (R Ohio) House Foreign Affairs.

S 2518. Promote interests of national defense through advancement of scientific and professional research and development program of Department of Defense. Johnston (D S.C.) Senate Post Office and Civil Service.

S 2478. Establish a system for classification and compensation of scientific and professional positions in the Government. Langer (R N.D.) Senate Post Office and Civil Service.

H Res 311. Appoint a select committee to conduct a full and complete investigation of the use of chemicals and other additives in food, medicine, and beverages to ascertain what deleterious effects such chemicals have on human life and health. Farbstein (D N.Y.) House Rules.

HR 8574. Amend the Internal Security Act of 1950. Walter (D Pa.) House Un-American Activities.

S 2481. Prohibit experiments upon living dogs in the District of Columbia and provide a penalty for violation thereof. Langer (R N.D.) Senate District of Columbia.

S 2489. Require use of humane methods of trapping animals and birds on lands and waterways under jurisdiction of U.S. Neuberger (D Ore.), Humphrey (Minn.), Kefauver (D Tenn.) Senate Interior and Insular Affairs.

S 2496. Amend act entitled "An act to promote the conservation of wildlife, fish, and game" approved 10 Mar. 1934, as amended, known as the Coordination Act. Watkins (R Utah) Senate Interstate and Foreign Commerce.

S 2554. Amend Federal Food, Drug, and Cosmetic Act to require that labeling of packages and cartons of cigarettes warn of health hazards involved in their use. Bennett (R Utah) Senate Interstate and Foreign Commerce.

S 2580. Amend section 314(c) of Public Health Service Act, to authorize Surgeon General to make certain grants-in-aid for support of public or nonprofit educational institutions which provide training and services in fields of public health and in administration of state and local public health programs. Hill (D Ala.), Ives (R N.Y.), Kennedy (D Mass.), McNamara (D Mich.), Cooper (R Ky.) Senate Labor and Public Welfare.

HR 8770. Provide a program for development of minerals resources of U.S., its territories, and possessions by encouraging exploration for minerals and providing for payments as incentives for production of certain minerals. Baring (D Nev.) House Interior and Insular Affairs.

S 2577. Preserve permanently as a national park, an area of national significance in Colorado and Utah, such park to be known as Dinosaur National Park, which shall supersede Dinosaur National Monument. Allott (R Colo.) Senate Interior and Insular Affairs.

Scientists in the News

DONALD W. KERST, professor of physics at the University of Illinois and technical director of Midwestern Universities Research Association (MURA), has joined John Jay Hopkins Laboratory for Pure and Applied Science of General Dynamics Corporation's General Atomic Division. Kerst, who invented the betatron, will be project leader of the laboratory's $10-million controlled thermonuclear research program, which is jointly sponsored by the Texas Atomic Energy Research Foundation.

KURT WEIL, senior engineer of Teleking Corporation's engineering department, has been named professor and head of the department of mechanical engineering at Stevens Institute of Technology. He succeeds JAMES H. POTTER, who will devote all his time to the duties of dean of the School of Graduate Studies.

GEORGE B. CRESSEY, Maxwell professor of geography at Syracuse University, is to spend the coming academic year at the American University of Beirut in Lebanon under a Department of State (Smith-Mundt) grant.

ROBERT L. SINSHEIMER, a member of the faculty at Iowa State College since 1949, has been named professor of biophysics at the California Institute of Technology. Sinsheimer has contributed to knowledge of the chemistry of nucleic acids. He is a specialist in the development and use of modern biophysical techniques and is interested in the current attempts to establish the relationships between molecular structure and genetic function.

IRA J. CONDIT, emeritus professor of subtropical horticulture at the University of California, Riverside, has received the Oberly memorial award of the American Library Association for producing the best bibliography in the field of agriculture during 1955 and 1956. Condit is senior author of *A Bibliography of the Fig,* which is compiled with Julius Enderud, senior laboratory technician at Riverside.

JOHN W. CELL has been named head of the department of mathematics in the School of Engineering, North Carolina State College. He succeeds H. A. FISHER, who retired on 1 July after serving as head of the department for 24 years.

BERNICE T. ELERT, medical technologist at Charles T. Miller Hospital in St. Paul, Minn., has received the 1957 Kimble medical technology research award of the American Society of Medical Technologists for developing a technique for measuring curare in a patient's blood.

WARREN G. HOAG, formerly professor of animal pathology at Virginia Polytechnic Institute, has been appointed staff scientist at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me. He will be in charge of a research program on animal health.

RICHARD M. FOOSE, formerly chairman of the geology department at Franklin and Marshall College, has been appointed to head the newly formed earth sciences department of Stanford Research Institute's Physical Sciences Division.

RICHARD H. KOSTERLITZ, who has served on the staffs of Cook County and Mt. Sinai hospitals in Chicago, Ill., has been named director of medical education for the new 800-bed Washington Hospital Center soon to be completed on a 47-acre tract in Washington, D.C. Funds for the appointment were made available by the Ford Foundation's Hospital Program.

Kosterlitz, a specialist in internal medicine, will not engage in any private practice. He will devote his time to teaching and developing and coordinating training programs. The position of director of medical education is new to most cities and rare in nonprofit, voluntary hospitals. Kosterlitz will foster research, medical school cooperation, and grant procurement. He will keep the staff informed of new drugs, techniques, and services and, in general, promote a high calibre of medical standards.

W. PAUL BRIGGS of Washington, D.C., secretary and executive director of the American Foundation for Pharmaceutical Education since 1951, has been selected by the past-presidents of the American Pharmaceutical Association to receive the 1957 Remington honor medal, pharmacy's highest recognition of service to the profession.

ARTHUR LOVERIDGE has retired from his post as curator of reptiles and amphibians at the Museum of Comparative Zoology at Harvard University. He and his wife plan to live on the island of St. Helena in the South Atlantic, 1200 miles from Angola—the island where Napoleon spent his last days. Loveridge is known to the lay public for a series of popular books on his East African expeditions and to scientists for the collection of 8469 specimens of reptiles and 11,597 amphibians as well as 3436 mammal skins and skulls.

Before he joined Harvard, Loveridge served in the botanical department of Manchester University (England) and in the department of zoology at the National Museum in Wales. In 1911, he left Wales to become curator of the Natural History Museum in Nairobi, Kenya Colony, until 1920, when he took the post of assistant game warden in Tanganyika Territory. He left Africa in 1923 and joined the staff of the Museum of Comparative Zoology the following year. In 1935 he became curator of reptiles and amphibians at the museum.

O. H. SMITH, emeritus head of the physics department at DePauw University, has been named visiting professor at Kalamazoo College (Mich.) under a grant from the John Hay Whitney Foundation. He will fill a vacancy created when RALPH O. KERMAN was granted a 2-year leave of absence to teach at the American University in Beirut, Lebanon.

JOHN L. ENYART has been appointed administrator of the Institute of Physical Medicine and Rehabilitation of New York University–Bellevue Medical Center. Enyart retired recently as naval surgeon in the Medical Branch of the Supreme Headquarters, Allied Powers Europe (SHAPE) in Paris.

J. G. VAN BUSSCHBACH, superintendent of schools in Amsterdam, the Netherlands, has received the $1000 William McDougall award for distinguished work in parapsychology. He was selected on the basis of his investigation of extrasensory perception between teacher and pupils in American schools. The award, which has been established by the Duke University Parapsychology Laboratory, will be given annually "to encourage and facilitate further research by the winner." The late William McDougall, for whom the award is named, headed the Duke psychology faculty from 1927 until his death in 1938 and was a pioneer in establishing parapsychology as a branch of university research.

MARIAN BALICKI, former head of the metallurgical engineering division at the Polytechnic Institute of Brooklyn, has assumed full-time duties as an engineering specialist in the department of physical metallurgy and ceramics at the Sylvania–Corning Nuclear Corporation, Bayside, N.Y. In his new post, he will be concerned with basic metallurgical and engineering research of background importance to reactor components technology.

JAMES E. BOYD, associate director of the Engineering Experiment Station at Georgia Institute of Technology, has been named director of the station. He replaces PAUL K. CALAWAY, who is returning to teaching as professor of chemistry at the institute.

HAROLD ST. JOHN, botanist at the University of Hawaii since 1929, has been appointed to the Wilder chair of botany, the first appointee since the chair was endowed in 1949. St. John has also been designated to direct the Harold L. Lyon Arboretum. Other recent changes in the botany department include the appointment of ALBERT J. BERNATOWICZ as department chairman.

Organizational changes involving E. D. SHIPLEY, A. H. SNELL, and J. L. FOWLER were announced recently at Oak Ridge National Laboratory, which is operated by the Union Carbide Nuclear Company for the Atomic Energy Commission. Shipley was appointed director of the newly formed Thermonuclear Experimental Division. He was succeeded as assistant director of ORNL by Snell, formerly director of the Physics Division. Fowler moved up from his former post as associate director of the Physics Division to succeed Snell as director.

FREDERICK A. COLLER has retired as chairman of the department of surgery at the University of Michigan, a position he has held since his appointment in 1930. He will continue on the medical faculty as a teacher, practitioner, and consultant. He will conduct a special course in the history of medicine that he originated a number of years ago.

Recent Deaths

EDITH ABBOTT, Grand Island, Neb.; 80; dean emeritus of the School of Social Service Administration at the University of Chicago; 28 July.

CHARLES E. BOLSER, Hanover, N.H.; 82; professor emeritus of chemistry at Dartmouth College; 29 July.

ORIS P. DELLINGER, Pittsburgh, Kans.; 79; emeritus dean and retired professor and head of biological sciences department at Kansas State Teachers College; 22 June.

EDWARD E. HITSCHMANN, Cambridge, Mass.; 86; founder and head of the Psychoanalytic Clinic of Vienna from 1922–38; member of the faculty and training psychoanalyst of Boston Psychoanalytic Institute; 31 July.

WILLIAM L. JENKINS, Bethlehem, Pa.; 59; head of the department of psychology at Lehigh University; 25 July.

JOSEPH M. PESTARINI, Rome, Italy; 70; consulting electrical engineer; taught in the United States at Manhattan College, Massachusetts Institute of Technology, Columbia University, and the University of Minnesota; also taught in Rome; inventor who designed metadynes, rotating amplifiers, and other machinery; 14 July.

WILLIAM ROWAN, Edmonton, Alberta, Canada; 65; professor of zoology at the University of Alberta; 30 June.

ALEXANDER SHAYNE, New York, N.Y.; 75; vice president and director of Bulova Research and Development Laboratories, Inc.; 26 July.

HAROLD R. SNOW, Bronxville, N.Y.; 62; research chemist; vice president and director of the American Oil Company; 31 July.

Reports

Hemoglobin M

A methemoglobin possessing a unique spectral absorption curve was found by Hörlein and Weber (*1*) in a family exhibiting a cyanotic condition in four generations. By interchanging the heme and the globin with the corresponding components of normal methemoglobin, the abnormality was found to reside in the globin fraction. On the basis of this description, the condition has been included among the abnormal hemoglobin syndromes, and the designation *hemoglobin M* has been applied to this protein (*2*).

A family of German extraction has now been discovered in New England possessing a similar "cyanotic" condition in at least four generations, both males and females being affected. This preliminary report concerns the findings in an extensive study of the hemoglobin from one of these affected individuals (*3*).

Venous blood from this individual had a chocolate-brown color, which was unaffected by shaking in the presence of air. Since methemoglobin as determined by the method of Evelyn and Malloy (*4*) was not increased, the presence of an abnormal pigment such as that described by Hörlein and Weber was suspected. When a modification of the starch electrophoretic technique of Kunkel (*5*) was used, the fresh hemolyzate was found to migrate to the cathode at *p*H 7.2 (sodium phosphate buffer containing 0.029 mole of Na_2HPO_4 and 0.010 mole of Na_2HPO_4 per liter) as a diffuse band. After prolonged electrophoresis, the diffuse band was seen to consist of three regions distinguishable by their color. The leading (cathodic) and the trailing margins of the hemoglobin band (hereafter identified as zone A and zone C, respectively) were of an oxyhemoglobin hue, while the area between these zones was brownish in color (zone B) (*6*). When hemoglobin from a normal individual was subjected to electrophoresis under these conditions, only a single band (paralleling zone A) was seen. Zone A was therefore presumed to be normal adult oxyhemoglobin.

Zones B and C were too narrow to permit isolation of a sufficient quantity of pigment from the individual zone without contamination from the adjoining regions. Zone C was therefore removed in its entirety, along with a small amount of zone B; the eluate from this is designated as "the eluate from zone C." Zone A was sufficiently broad to permit isolation of its pigment without contamination, and its eluate was used throughout as a control, representing the reactions of normal adult oxyhemoglobin. The spectral characteristics of the hemoglobin derivatives prepared from this eluate did not differ significantly from the published data for normal hemoglobin (*7*). Spectrophotometric studies were made of the eluates of the various regions, and as is discussed in the following paragraphs, evidence was obtained indicating that the zone-C eluate contained both an abnormal oxyhemoglobin and an abnormal methemoglobin.

The pigments of the two regions were recovered by eluting with sodium phosphate buffer of *p*H 6.5. The spectral absorption curve of the zone-A eluate exhibited maxima at 540 and 570 mμ (*8*). These maxima were indistinguishable in their location from those of normal oxyhemoglobin, as was evidenced by comparison with untreated hemolyzates of normal bloods.

The spectral absorption curve of the zone-C eluate exhibited maxima at 495, 530, and 570 mμ and, in addition, a slight inflection at 600 mμ. The spectral characteristics at 495 and 600 mμ were thought to be the result of the contaminating pigment of zone B. The maxima at 530 and 570 mμ indicate the presence of an oxyhemoglobin, in agreement with the visual impression of an oxyhemoglobin hue in zone C. The discrepancy between 530 and 540 mμ for the respective maxima for zones A and C is of doubtful significance, in view of the limitations of the spectrophotometer used and the fact that the zone-C eluate contains a mixture of pigments.

Further verification of the presence of an oxyhemoglobin in zone C was obtained by the addition of an oxidizing agent (potassium ferricyanide) to the eluate. After such treatment, the peaks at 530 and 570 mμ were obliterated (Fig. 1, zone C), indicating their origin from an oxidizable pigment such as an oxyhemoglobin. The curve so obtained closely resembles that published by Hörlein and Weber (*1*) for their abnormal methemoglobin.

The spectral changes occurring when normal oxyhemoglobin is oxidized to methemoglobin are illustrated by the response of the eluate of zone A (Fig. 1). The oxyhemoglobin peaks at 540 and 570 mμ are absent, and the peaks due to the presence of methemoglobin (500 and 630 mμ) are apparent. The failure of a peak to appear at 630 mμ after oxidation of the oxyhemoglobin from zone C indicates that its methemoglobin differs from this derivative of normal hemoglobin in its spectral characteristic. This oxyhemoglobin, which differs both electrophoretically and spectroscopically (as the methemoglobin derivative) from normal adult hemoglobin, has been named *hemoglobin M* in accordance with the application of this term (*2*) to the clinically and chemically similar cases of Hörlein and Weber (*1*).

The pigment of zone B which contaminates the eluate of zone C can be shown to be a methemoglobin, as follows. Addition of sodium cyanide to the zone-C eluate results in a decrease in optical density at 500 mμ and a considerable increase in optical density at

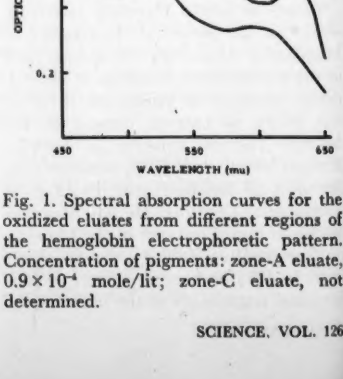


Fig. 1. Spectral absorption curves for the oxidized eluates from different regions of the hemoglobin electrophoretic pattern. Concentration of pigments: zone-A eluate, 0.9×10^{-4} mole/lit; zone-C eluate, not determined.

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table or one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in Science 125, 16 (4 Jan. 1957).

540 mμ. These are the results expected if a cyanmethemoglobin is formed (by the reaction of cyanide with methemoglobin), with spectral properties resembling the normal compound. If this solution is now oxidized with potassium fericyanide and again treated with sodium cyanide, a curve with a single maximum, in the visible region, at 535 mμ results. (When the zone-A eluate was similarly treated, the maximum was found to be at 545 mμ. In addition, the maximum for the zone-C pigment was broader than that for zone A. As was noted in the case of the oxyhemoglobin spectra, such differences cannot be considered significant at the present time.) From this it is concluded that all of the pigment in the oxidized eluate of zone C is reactive with cyanide and, hence, presumably is methemoglobin. On the basis of these findings, it may be stated that the original eluate from zone C is a mixture of methemoglobin and oxyhemoglobin.

We have as yet no direct proof that the pigment of zone B is formed from the oxyhemoglobin of zone C, since we have not succeeded in separating them sufficiently to study their interconversion in detail. The relatively greater cathodic migration of the zone-B pigment suggests this relationship however. If the two pigments differ only in the valence of the iron of the heme group (+2 for the oxyhemoglobin and +3 for the methemoglobin), then the methemoglobin would be expected to migrate cathodically slightly in advance, since it would have the greater positive charge. If we assume that these two pigments are so related, the spectral curve of the oxidized eluate of zone C (Fig. 1) is that of pure methemoglobin M. The absence of a maximum at 630 mμ explains the failure to detect methemoglobin by the method of Evelyn and Malloy (*4*), since this test is dependent on the disappearance of this maximum after chemical treatment. The finding of a hemoglobin derivative with spectral characteristics in the visible region differing from those of the normal compound is unique, since the location of maxima is nearly identical, even when hemoglobin derivatives from different vertebrate species are compared (*7*).

In summary, a second family with methemoglobinemia of the Hörlein and Weber type has been discovered. Both normal oxyhemoglobin and an abnormal oxyhemoglobin, designated *hemoglobin M*, have been identified in the hemolyzate from one affected individual. An abnormal methemoglobin differing in its visible spectral characteristics from normal methemoglobin is also present. It is tentatively concluded that the abnormal oxyhemoglobin is the precursor of the abnormal methemoglobin, and in consequence the term *methemoglobin M* has been applied to the latter pigment. From the available family history, it is expected that hemoglobin M will show the dominant inheritance pattern usually found with the abnormal hemoglobins. The individual described herein then represents the hemoglobin-M trait.

PARK S. GERALD*
CHARLES D. COOK
LOUIS K. DIAMOND
Department of Pediatrics, Harvard Medical School and *Children's Medical Center, Boston, Massachusetts*

References and Notes

1. H. Hörlein and G. Weber, *Deut. med. Wochschr.* 73, 476 (1948).
2. K. Singer, *Am. J. Med.* 18, 633 (1955).
3. We are indebted to G. N. French for referring this patient to us.
4. K. A. Evelyn and H. T. Malloy, *J. Biol. Chem.* 126, 655 (1938).
5. H. G. Kunkel and G. Wallenius, *Science* 122, 288 (1955).
6. We are unable to illustrate this, since the distinction between the colored zones is not adequately reproduced in black and white.
7. R. Lemberg and J. W. Legge, *Hematin Compounds and Bile Pigments* (Interscience, New York, 1949).
8. All spectrophotometric measurements were made with a Bausch and Lomb "Spectronic 20."

* U.S. Public Health Service research fellow of the National Heart Institute.

3 June 1957

Nonspecific Inhibition of Vaccinia Hemagglutinin

Knowledge concerning the occurrence of nonspecific (nonantibody) inhibitors of viral hemagglutinins in body fluids is essentially limited to influenza virus. The present report (*1*) concerns the hemagglutinin of vaccinia virus. The hemagglutinin inhibitor to be described was found in the plasma of the Lettré, hyperdiploid line of the Ehrlich ascites carcinoma of the mouse. The procedure used to measure the inhibitor was the same as that described in a previous paper (*2*), except that calcium chloride was omitted from the diluent. Five agglutinating doses of the IHD-E strain of virus (*3*) were employed in the hemagglutination inhibition tests. The method of inoculating mice has been described previously (*2*).

Variation of inhibitor concentration with the age of the tumor is shown in Table 1. The concentration is highest in the older tumors. That the inhibitor is not antibody is apparent from two facts: (i) it is not present in the serum of tumor-bearing mice; and (ii) it is inactivated by heating at 60°C for 30 minutes. Of additional interest is the observation that it has no neutralizing action on the infectivity of vaccinia virus.

A sample of the ascites tumor was disintegrated by shaking with glass beads (*4*). The supernatant of this preparation, following centrifugation, did not show an increase in titer over that of the cell-free fluid from an untreated control specimen. This was equally true of both the 5- and 13-day tumors. Disintegrated preparations made from washed cells, which had been resuspended in 0.85-percent NaCl, yielded no inhibitor at all.

When cell-free tumor fluid was mixed with an equal volume of packed, agglutinable fowl cells, and specimens were held at room temperature and at 4°C for 1 hour, the inhibitor was not adsorbed from the fluid in either case. A 1-percent suspension of fowl cells was prepared in tumor fluid, and samples were held at room temperature and at 4°C for 1 hour. The cells were subsequently washed with 0.85-percent NaCl and used to determine the hemagglutination titer of a suspension of vaccinia virus. The titers were the same as those of control suspensions that had not been in contact with tumor fluid. The evidence suggests that the inhibitor acts against the hemagglutinin, and not against the fowl cells.

Inhibition was also observed with other strains of vaccinia virus. In comparative tests in which five agglutinating doses of the IHD-E, Nelson, and Levaditi strains were employed, inhibition occurred with all three, and to the same titer.

Upon the dialysis of cell-free tumor fluid against distilled water at 4°C for 24 hours, the inhibitor was not removed. However, it was found only in the precipitate in the dialyzing bag. When the volume in the bag was adjusted to what it had been prior to dialysis, it was found that the precipitate represented 7 percent of the original volume. A sample of the thoroughly resuspended contents of the dialyzing bag was brought back to solution by adding NaCl. The titer of this sample was the same as that of the

Table 1. Vaccinia hemagglutinin inhibitor concentration in tumors of different ages. Titers were determined individually on the cell-free tumor fluids obtained from each of three mice which were sacrificed daily.

Age of tumor (day)	Titer		
	Mouse No. 1	Mouse No. 2	Mouse No. 3
3	< 10	10	< 10
4	20	20	20
5	20	40	10
6	40	40	80
7	80	80	80
8	80	20	40
9	40	40	40
10	160	160	80
11	40	80	40
12	160	160	160
13	320	160	80
14	160	160	160

original tumor fluid, thus indicating no significant loss of activity during dialysis.

By the slow addition of solid ammonium sulfate to tumor fluid, a cumulative saturation series was carried out at 10-percent intervals. This was done at 4°C. No precipitate occurred at 10-percent saturation. Inhibitor activity was present in the precipitates at 20- and 30-percent saturations. No further amount of inhibitor was precipitated at 40-percent saturation or thereafter.

It appears that the inhibitor may be an enzyme. Efforts to identify it are continuing. It is of interest to speculate whether or not there is a connection between the inhibitor and the fact that, on serial passage in the tumor, the IHD-E virus loses the capacity to produce hemagglutinin (*3*).

WILLIAM A. CASSEL*
BARBARA FATER
Langbord Virus Laboratory, Hahnemann Medical College, Philadelphia, Pennsylvania

References and Notes

1. This study was aided by a grant from the American Cancer Society.
2. W. A. Cassel, *Cancer Research*, in press.
3. ———, *Virology*, in press.
4. P. M. Nossal, *Australian J. Exptl. Biol. Med. Sci.* 31, 583 (1953).

* These studies were carried out during the tenure of a Lederle Medical Faculty award.

20 May 1957

Production of Laminar Lesions in the Cerebral Cortex by Heavy Ionizing Particles

One of the difficulties in studying the connections and functional capacity of cortical neurons results from the fact that no technique thus far employed permits selective destruction of a single cortical layer. It appears that heavy ionizing particles of high and nearly equal energies may be used to produce such destruction. The steep rise in linear energy transfer near the end of the particle's range, the sharp cut-off in energy transfer at the end of the range, and the relatively straight trajectory are properties of heavy ionizing particles which are useful in this connection. High-energy protons and deuterons have already been extensively employed by Tobias and his coworkers (*1–3*) for irradiation of the pituitary.

In our pilot experiments (*2*) production of laminar lesions was attempted with 10-Mev protons. The cyclotron at Brookhaven National Laboratory was used. The beam passed from vacuum into air through a brass foil about 0.025 mm thick. After it has passed through a circular defining aperture 0.5-cm in diameter, the beam was measured by an ionization chamber consisting of two sheets of aluminum foil (each 0.024 mm thick), spaced 1.27 cm apart. The beam traversed a total air path of about 10 cm before it reached the exposed cortex of a deeply anesthetized cat. Under the experimental conditions used, the protons entered the tissue with a residual range of about 0.9 mm and caused maximal destruction at a depth of about 0.8 mm.

In two cats, five lesions were produced in the lateral and suprasylvian gyri of the cerebral cortex. After irradiation, the animals were permitted to survive 10 weeks. They were then sacrificed, and their brains were cut serially. The sections were stained with thionine. The intensity of the beam (number of particles per unit area, per unit time) was held constant, and exposure times were varied for different lesions. Figure 1 shows the typical appearance of one irradiated cortical field. The dosage here was intended to be 5000 rad at the peak of the energy-transfer curve. This estimate, however, may be in error by a factor of 2 or more because of nonlinearity of the ion chamber that was used for measurement. It will be noticed that in the middle of the cortical field there is a band (marked by an *x*) in which all the nerve cells disappear. The small cells visible in this strip are glia cells. The limits of the destructive lesions are sharp, and the total width of the destroyed cortex measures about 100 μ. The lesion covers a circular area, the diameter of which approximates closely the size of the aperture (0.5 cm).

It is noteworthy that, apart from the sharply demarcated destroyed zone, the rest of the cortex appears normal. The first, second, and third cortical layers above the lesion display a substantially intact cytoarchitectonic structure even though these layers were traversed by the proton beam. If these layers are damaged, the damage is apparently minor by comparison with that in the zone of total destruction. Likewise, below the lesion, the fourth, fifth, and sixth layers appear intact. A survey of serial sections

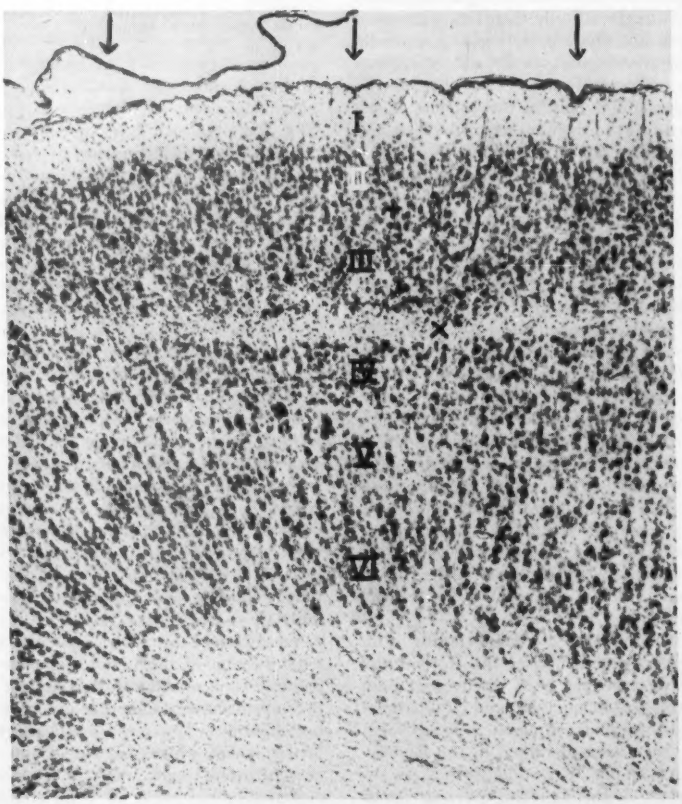


Fig. 1. Cortex of the lateral gyrus of the cat, showing a laminar lesion produced by 10-Mev protons. Arrows indicate the direction of the beam. Roman numerals denote cortical layers, and *x* indicates the zone of destruction. Note the sharp borders of the destructive lesion and the normal cytoarchitecture of the remaining cortex. Dura was not opened during irradiation. (Cat 2, section 330, magnification × 68.) Shrinkage of the tissue owing to imbedding is about 30 percent.

reveals that there are no hemorrhages, necrotic foci, or areas of gliosis. The main damage in all lesions is a narrow band of total destruction and, for our lowest radiation dose, this band is the only striking evidence of destruction in Nissl preparations, when such sections are examined under relatively low power.

Production of lesions at appreciably greater depth will require the use of particles of higher energy. Deuterons at 20 Mev may be expected to produce lesions at any desired depth within the cortex.

Production of narrow lesions of total destruction, sharply bordering on normal or nearly normal tissue, promises to be of great value as a research tool for studies of connections and discharge patterns of cortical neurons. Studies on standardization of this technique preliminary to such work are now in progress.

L. I. Malis, R. Loevinger, L. Kruger, J. E. Rose

Department of Neurological Surgery and *André Mayer Department of Physics, Mount Sinai Hospital, New York,* and *Departments of Physiology* and *Psychiatry, Johns Hopkins University, School of Medicine, Baltimore, Maryland*

References and Notes

1. C. A. Tobias, H. O. Anger, J. H. Lawrence, *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 67, 1 (1952); C. A. Tobias *et al., ibid.* 72, 1 (1954); C. A. Tobias *et al., Univ. of Calif. Radiation Lab. Rept. No. 3035* (1955).
2. We wish to express our appreciation to C. P. Baker and L. E. Farr of Brookhaven National Laboratory, who made the initiation of this work possible. We also thank S. Feitelberg, director of the André Mayer department of physics, Mount Sinai Hospital, New York, for his stimulating and valuable suggestions in the planning of these studies.

21 May 1957

Reversal of Inhibitory Effects of Ozone on Oxygen Uptake of Mitochondria

There is evidence to suggest that ozone may be present in the Los Angeles atmosphere in sufficient concentrations to damage plants and affect animals. It has been reported that concentrations of ozone of from 25 to 50 parts per 100 million by volume (pphm) that existed for long periods of time were lethal to guinea pigs, and particularly so when the animals were infected with tuberculosis (*1*). It has been reported that a noticeable irritation to human beings results from concentrations of 20 pphm (*2*). Middleton *et al.* (*3*) found that ozone at concentrations as small as 20 pphm produced visible leaf damage to pinto beans after a 2-hour exposure.

Renzetti (*4*) has reported that concentrations of ozone of up to 35 pphm have been recorded on days of heavy smog in Pasadena, Calif. Littman and Marynowski (*5*) found that from 30 to 45 percent of the total oxidant in the Los Angeles atmosphere resembles ozone. Oxidant levels of as high as 90 pphm have been recorded for short periods in Los Angeles (*6*), and smog levels in the basin reach a point where they cause appreciable irritation on about 70 days of each year (*7*).

Small concentrations of ozone have been shown to affect the respiration of plant cells (*8*). An important part of the respiratory activity in certain plant and animal cells has been shown to be associated with the mitochondria. Because of this, an understanding of the effects of ozone on mitochondria could be important for the prevention and control of air-pollution damage to organisms.

Ozone, produced by passing oxygen through a high-voltage discharge tube, was diluted with filtered air through rotameters to give the desired concentration. The air in every case was filtered through activated charcoal. The concentration of ozone for each experiment was continuously recorded with an ultraviolet photometer (Harold Kruger Instruments, model 52) and was also determined by iodometric titrations.

Mitochondrial preparations from cabbage and spinach were obtained by methods that have been described previously (*9*). The methods of Kielley and Kielley (*10*) were used for the preparation of the cow's liver mitochondria. Mitochondria isolated from 700 g of plant tissue or from 50 g of liver were suspended in 48 ml of 0.6*M* sucrose, 0.1*M* potassium phosphate buffer at *p*H 7.0. Aliquots of the mitochondrial suspensions of 6 ml each were swirled with ozone-free air or the desired concentration of ozonated air in 2-lit volumetric flasks which had previously been flushed with either the ozone-free air or the ozonated air mixtures. The volumetric flasks were rotated uniformly in an ice bath to maintain a thin layer of suspension on the walls of the flasks as well as to maintain the low temperature required to preserve the mitochondria.

Table 1. Effect of ozone on plant and animal mitochondria. All values reported are average values from duplicate flasks. These duplicates did not vary from each other by more than 5 percent. Where no figures are given, no analysis was made.

Additions (μmole)	Oxygen taken up (μmole)		Reduced compounds remaining (μmole)	
	Treatment		Treatment	
	Air	Ozone	Air	Ozone
Cabbage	*4.5 μmole O_2/flask*		*Ascorbic acid*	
None	11.6	3.3	0.19	0.04
GSH, 16	11.2	4.9		
AA, 20	10.2	8.5	7.5	5.8
GSH, 16, + AA, 20	9.3	9.6	6.4	4.9
Spinach	*5 μmole O_2/flask*		*Glutathione*	
None	10.7	7.1	0.07	0.01
GSH, 48	10.8	9.1	35.5	12.0
Cow liver	*7 μmole O_2/flask*			
None	3.2	1.9		
GSH, 20, + AA, 20	5.8	5.2		

After the air or ozone treatment, 2 ml of the mitochondrial suspensions were added, with 1 ml of cofactors, to each Warburg flask. The usual Warburg techniques (*9*) were used to test for citric-acid-cycle activity. A concentration of 0.006*M* potassium citrate was used as the substrate for the mitochondria. Ascorbic acid (AA) and reduced glutathione were added directly to the Warburg flasks. Conventional methods were used for the analysis of the ascorbic acid (*11*) and the sulfhydryl compounds (*12*) at the end of the experiments.

The results in Table 1 indicate that when reduced glutathione and ascorbic acid were added together to the ozone-treated mitochondrial suspensions, an apparent reversal of the ozone inhibition took place. Partial reversal of the ozone inhibition was obtained when the two compounds were added separately. This reversal of ozone inhibition has been repeated more than 13 times in separate experiments. Data for both oxygen uptake and CO_2 evolution verified the effect.

The mitochondria were treated with ozone before the substrates, cofactors, and reducing compounds were added. These mitochondria were therefore initially changed by the treatment with ozone. Later addition of ascorbic acid or reduced glutathione apparently overcame part of this change and, in some cases, brought the oxygen uptake completely back to that of the air control.

When 15 μmole of hydrogen peroxide

was added to an untreated cabbage mitochondrial preparation, there was an immediate evolution of oxygen, which continued for some time. This was presumably attributable to the presence of catalase. It took 76 μmole of hydrogen peroxide per flask to cause a 30 percent inhibition in rate of oxygen uptake. This 30 percent inhibition was reversed with 16 μmole of ascorbic acid plus 20 μmole of reduced glutathione. These experiments indicated that the action of ozone did not involve the intermediate formation of hydrogen peroxide, since the relatively large amounts of hydrogen peroxide required for inhibition could not have been formed from the smaller amounts of ozone that were added. The results also suggested that ozone and hydrogen peroxide might have been acting in a similar manner, since reversal could be obtained in both cases. If this were the case, then the action of these agents could have been attributable to simple oxidation, and other strong oxidizing agents (such as peroxyacids and ozonides) could perhaps produce a similar reversible inhibition.

The addition of excess cofactors—sodium ethylene-bis(dithiocarbamate), sodium bisulfide, cysteine, 2,3-dimercapto-1-propanol—to ozone-treated mitochondria did not reverse the ozone inhibition. In many cases, the addition of these compounds inhibited oxygen uptake. These experiments suggested that some type of specificity existed for the reversing agent.

The results presented here suggest that the effects of small amounts of ozone on cabbage, spinach, and liver mitochondria were reversed by ascorbic acid, reduced glutathione, and ozone-affected enzymes that were associated with the mitochondrial citric-acid-cycle activity.

HUGH T. FREEBAIRN
Department of Plant Biochemistry, University of California Citrus Experiment Station, Riverside

References

1. H. B. McDonnell and J. A. Off, *Agr. Chemicals* 13, 19 (1930).
2. S. Wilska, *Acta Chem. Scand.* 5, 1359 (1951).
3. J. T. Middleton, J. B. Kendrick, Jr., E. F. Darley, *Proc. Third National Air Pollution Symposium, Pasadena, Calif.* (18 Apr. 1955).
4. N. A. Renzetti, *J. Chem. Phys.* 24, 909 (1956).
5. F. E. Littman and C. W. Marynowski, *Anal. Chem.* 28, 819 (1956).
6. *Los Angeles County Air Pollution Control Report: Smog Brief No. 10* (1956).
7. *Los Angeles County Air Pollution Control Report* (Sept. 1956).
8. L. C. Erickson and R. T. Wedding, *Am. J. Botany* 43, 32 (1956); G. W. Todd, *Physiol. Plantarum* 9, 421 (1956).
9. H. T. Freebairn and L. F. Remmert, *Plant Physiol.* 31, 256 (1956).
10. W. W. Kielley and R. K. Kielley, *J. Biol. Chem.* 191, 485 (1951).
11. K. A. Evelyn, H. T. Malloy, C. Rosen, *ibid.* 126, 645 (1938).
12. R. E. Benesch, H. A. Lardy, R. Benesch, *ibid.* 216, 663 (1955).

24 May 1957

Effect of Lysergic Acid Diethylamide on Absolute Visual Threshold of the Pigeon

There have been many recent reports that human subjects receiving small doses of lysergic acid diethylamide (LSD) tend to behave in some ways like psychotic patients. These reports have stimulated efforts at careful specification of the psychological and physiological effects of LSD. Prominent among the effects found thus far have been disturbances of visual functions, including apparent changes in visual sensitivity. E. V. Evarts (*1*) recently reported that monkeys recovering from large doses of LSD were active but behaved as though they were blind. Carlson (*2*) has noted a slight rise in the absolute visual threshold of human subjects following intravenous administration of 100 μg of LSD. In a related neurophysiological study (*3*), LSD markedly reduced the postsynaptic response in the lateral geniculate nucleus to stimulation of the optic nerve of the cat.

Such findings suggest that elevation of the absolute visual threshold is characteristic of the action of LSD. The present study (*4*) uses a recently devised technique (*5*) to measure this effect in the pigeon. The method is rather complex and its restatement here will be brief. The pigeon stands in a light-tight box and views a stimulus patch fixed in the wall. It pecks one response key when the stimulus patch is visible and another key when the patch appears dark. These pecks, operating through automatic control circuits, cause the intensity of the stimulus to vary up and down across the pigeon's absolute threshold. A recorder charts the stimulus intensity, indicating the bird's threshold through time. The automatic controls provide the pigeon with periodic rewards of food for correct responses.

The subjects were three male domestic pigeons (White Carneaux). The bird to be tested first was dark-adapted for at least 1 hour in the experimental box. The stimulus patch was then illuminated by a light beam of 500-mμ wavelength from a Bausch and Lomb grating monochromator. The bird responded to this stimulus for at least 30 minutes, or until its threshold appeared to be stable. Then the experimental box was opened in darkness, and a dose of water or LSD solution (100 or 300 μg/kg) was administered either orally or by intraperitoneal

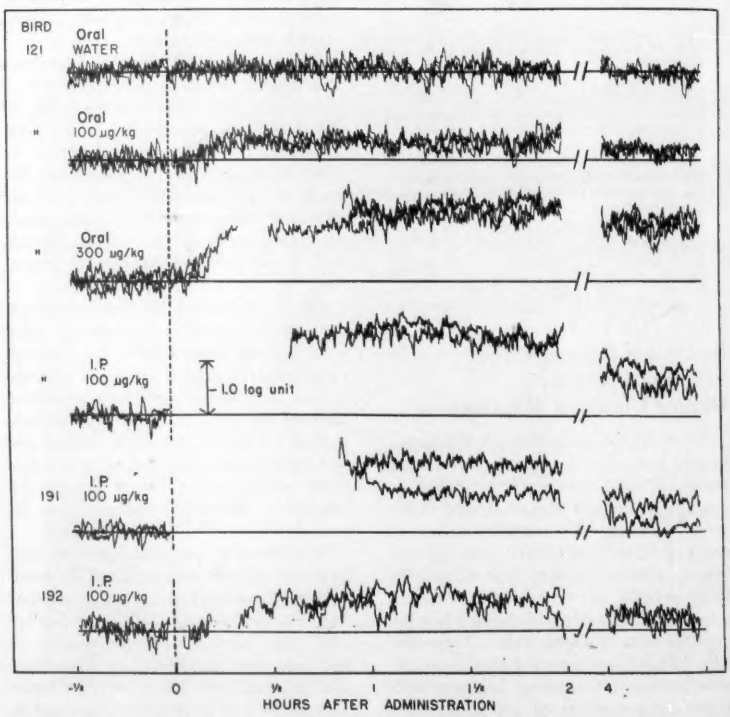


Fig. 1. Effect of LSD on the pigeon's absolute visual threshold. Vertical shifts in the curves represent changes in the brightness of a "just visible" stimulus patch. A single oral dose amounted to about 4 ml of solution (10 ml/kg). A single intraperitoneal dose amounted to about 0.4 ml of solution (1 ml/kg).

injection. Following administration, the bird's threshold was recorded for 2 hours. The bird then rested in the dark until a 30-minute test was made during the fifth hour after administration of the dose. In several instances, a final test was made about 22 hours after administration of LSD. The birds were allowed from 3 days to 2 weeks for recovery between doses of LSD.

Some of the original data are reproduced in Fig. 1. The curves represent the brightness of the stimulus patch as a function of time before and after dosage. The base line for each curve extends through the midpoint of the threshold recorded before a dose was given. Three curves from single sessions are superimposed in the case of data obtained after administration of oral doses, while two curves make up each function in the case of data obtained after intraperitoneal administration. The uppermost function in Fig. 1 illustrates typical control data. Gaps appear in the records when the bird failed to respond. This often happened for a time after administration of the larger doses of LSD.

It is apparent that LSD caused a striking rise in absolute threshold. Bird 121 was affected the most. It showed a swift and substantial rise in threshold with both doses and with both routes of administration. Intraperitoneal doses of 100 μg/kg given to this bird produced the largest threshold rise that was observed. The rise amounts to approximately 1.8 log units, a linear increase of roughly 60-fold.

Samples of the data from the other two pigeons are plotted as the lowest two functions in Fig. 1. The threshold changes observed in these birds were similar to those found with pigeon 121, though of somewhat smaller magnitude.

In most cases, the effect of LSD had diminished considerably by the fifth hour after administration. This was especially true in the case of intraperitoneal dosage. In no case was a threshold elevation still evident in the tests made after 22 hours.

It might be argued that the rise in threshold is only apparent and that the findings actually represent a failure by the birds to perform correctly in the discrimination situation. However, in a previous study, LSD at these dose levels improved the pigeon's performance on a visual discrimination task, rather than producing a decrement (*6*). Furthermore, spurious departures from a stable threshold have been marked in past studies by increased variability, rather than by the stable shift in level evidenced here.

Small doses of LSD thus appear to affect the visual threshold of the pigeon without grossly disturbing motor or discriminative functions. This fact may be a valuable clue in understanding the physiological action of the drug. It also suggests the use of visual threshold measurement as an assay technique in the study of LSD and related substances.

DONALD S. BLOUGH

Laboratory of Psychology,
National Institute of Mental Health,
Bethesda, Maryland

References and Notes

1. E. V. Evarts, *Arch. Neurol. Psychiat.* 75, 49 (1956).
2. V. R. Carlson, personal communication.
3. E. V. Evarts *et al.*, *Am. J. Physiol.* 182, 594 (1955).
4. I acknowledge the aid of William H. Jones in running the experiments and in preparing the figures.
5. D. S. Blough, *Science* 121, 703 (1955).
6. ———, *Ann. N.Y. Acad. Sci.* 66, 733 (1957).

17 May 1957

Age of the Sandia Culture

The introduction of radiocarbon dating has proved that the figures found in America by geologic and archeological dating are obsolete. Therefore, in his lecture on "Early man in North America," given on 17 July 1951 at the University of Erlangen, Germany, F. C. Hibben (*1*) used explicitly and exclusively figures found out by C^{14} measurement and communicated the dates of 9000 B.C. (maybe an estimate based on Libby's Two Creeks C^{14} dates published on 2 Feb. 1951?) (*2*) for the Folsom layer and 17,000 B.C. for the Sandia layer in Sandia Cave, N.M.

In a paper (*3*) published some months later, I quoted from this lecture an *age* (that is, years before present time) of 11,000 and 19,000 years, respectively, for the Folsom and Sandia layers in Sandia Cave; this dating of mine is, of course, identical with Hibben's. Consequently, I am not in error in my dates, but Hibben is in error when he maintains that his dates were derived by stratigraphy from Bryan's geologic work. K. Bryan (*4*), in his appendix to Hibben's excellent monograph on Sandia Cave (*5*), placed the Sandia layer just before 25,000 years before the present and the Folsom level just after this date on geologic grounds. I cannot understand how it is possible to derive from this geologic dating the figures 9000 and 17,000 B.C. The date 17,000 B.C. (omitting the appended "-plus") is approximately the mean of Hibben's (*6*) alleged C^{14} dates (17,000-plus and 20,000-plus years ago). Consequently, I have not confused geologic and C^{14} dating.

H. R. Crane (*7*) found, by C^{14} measurement of two ivory samples from the Sandia level, "that there appears to be no significant difference in counting rate between the Sandia samples and the control samples of dead CO_2, when the statistical limits and the degree of consistency between runs are considered." According to his measurement (*7*, Fig. 1, p. 689) the ivory samples are older than 35,000 years. I, therefore, do not understand why, later on, Crane (*8*) dated the two Sandia samples as older than 20,000 years only.

The Pleistocene stratigraphy of Sandia Cave has been stated by Hibben (*5*, pp. 11–18), and Bryan (*4*, p. 48) as follows: layer 1, upper cave breccia, 1 to 4 ft thick (Folsom layer); layer 2, yellow ochre, 2 in. to 2 ft thick (sterile); layer 3, lower cave breccia, 0 to 3 ft thick (Sandia layer); layer 4, basal clay, 0 to 2 ft thick (sterile).

According to R. Lais (*9*), the sequence of the Pleistocene stratigraphy displayed by cave fill depends on considerable climatic fluctuations. The degree of chemical weathering of limestone debris in caves is a function of temperature, moisture, and time. Layers 2 and 4 of the afore-mentioned sequence are the residues of dissolved limestone and are thus the products of very long, warm (at least temperate), and moist intervals. In Central European caves, the basal clay was deposited during the last Interglacial period, as evidenced often by paleontological and archeological findings.

Layer 2 of Sandia Cave certainly correlates with the European *Höhlenlehm* (cave loam), mostly about 0.20 m thick, intercalated between the lower breccia (formed by frost action) containing Mousterian artifacts and the upper breccia containing Upper Paleolithic levels. In Europe the *Höhlenlehm* corresponds to the Göttweig loam known from cross sections of loess; both were formed during a long temperate interstadial (formerly called Würm I/II), the Göttweig Interstadial (*10*), preliminarily dated by C^{14} at Groningen as about 42,000 to 28,000 before the present. The North American equivalent of the Göttweig Interstadial has been recently discovered by R. F. Flint and M. Rubin (*11*) in Ohio and estimated to have been about 16,000 years in length; this interstadial separates the Early Wisconsin and the Main Wisconsin stadials corresponding to the Altwürm and Hauptwürm stadials in Europe.

So long as this correlation has not been refuted by incontestable evidence, we dare ascribe the Sandia level of Sandia Cave to the Early Wisconsin stadial (in agreement with Crane's first C^{14} dating), for in the meantime some archeological sites in North America have been dated by C^{14} as older than 37,000 years—namely, Lewisville (*12*), Tex., and Santa Rosa Island (*13*) off

Santa Barbara, Calif. The Sandia projectile points have often been compared with the Solutrean points of France, but Hibben (*5*, p. 24) is right when he says: "This similarity to Solutrean material does not imply connection or contemporaneity with it, although the resemblance is remarkable." The Solutrean in France falls in a late period of the Hauptwürm stadial after 24,000 years before the present.

HUGO GROSS

Bamberg, Germany

References and Notes

1. F. C. Hibben, *Science* **125**, 235 (1957).
2. J. R. Arnold and W. F. Libby, *ibid.* **113**, 117 (1951).
3. H. Gross, *Bull. Texas Archaeol. and Paleontol. Soc.* **22**, 114 (1951).
4. K. Bryan, *Smithsonian Inst. Misc. Collections* **99** (23), 58, 59, Fig. 9 (1941).
5. F. C. Hibben, *ibid.*, pp. 1–44.
6. ———, *Science* **122**, 688 (1955).
7. H. R. Crane, *ibid.* **122**, 689 (1955).
8. ———, *ibid.* **124**, 664 (1956).
9. R. Lais, *Uber Höhlensedimente.-Quartär* **3**, 56 (1941).
10. H. Gross, *Eiszeitalter und Gegenwart* **7**, 87 (1956).
11. R. F. Flint and M. Rubin, *Science* **121**, 649 (1955).
12. Anonymous, *Science* **124**, 396 (1956).
13. A. D. Krieger, *Am. Antiquity* **22** (July 1956).

28 May 1957

Heterogeneity of Nuclear Ribonucleic Acid

There is an increasing body of evidence which supports the hypothesis that the ribonucleic acid (RNA) which is synthesized in the nucleus acts as a medium for the transfer of genetic information to centers of protein synthesis in the cytoplasm. Correlatively there has developed the concept that cytoplasmic RNA is derived from the nucleus (*1*, *2*). At the same time, there are at least two observations which do not appear to be compatible with such a hypothesis: (i) observed differences in the quantities of the bases in nuclear and cytoplasmic RNA isolated from the same cell type (*3*), and (ii) the differential incorporation of labeled precursor into nuclear and cytoplasmic RNA (*2*). The demonstration of heterogeneous populations of RNA molecules in the nucleus and cytoplasm would help to resolve these incompatibilities (*4*). In the experiments described here, the nuclear RNA of the starfish oocyte has been separated into two fractions which have striking differences in metabolic activity.

Starfish oocytes *in ovarii* were placed in sea water containing approximately 0.5 μc of P^{32} per milliliter. At the times indicated in Fig. 1, about 80 g of ovarian material was removed, and the nucleoli were isolated in sucrose solutions (*5*, *6*). The phosphorus-containing compounds were separated by a modification of the procedure described by myself (*6*) as follows: The "soluble P" fraction was removed by extracting with 0.1*N* HCl for 15 minutes at 0°C. The P found in this fraction was organic phosphorus, presumably in nucleotides. The precipitate was then extracted in hot alcohol-ether (3/1) by refluxing for 1 hour. "RNA_1" was separated by allowing the precipitate from the fractions to stand for 1 hour at 0°C in 1*N* HCl. This fraction contained the typical bases of nucleolar RNA as well as ribose and phosphorus in the proportions expected in RNA. "RNA_2" was extracted by heating the remaining precipitate in 1*N* HCl for 20 minutes at 90°C. The residue from these extractions contained only protein-bound P. "Cytoplasmic RNA" was separated by the same procedure except for the omission of cold 1*N* HCl extraction. The cytoplasm was prepared as an acetone-dried powder from the ovarian homogenate after the initial removal of nuclei and nucleoli by centrifugation (*5*). The extracts were plated and counted to 5-percent reproducibility. Phosphorus was determined by the method of Wiame (*7*), and by calculation from ultraviolet absorption at 260 mμ. Agreement between duplicate P determinations and ultraviolet-calculated P in the RNA fractions was within 8 percent.

As is readily seen from Fig. 1, RNA_1 and RNA_2, which differ in their solubility in cold 1*N* acid, demonstrate striking differences in specific activity with respect to time. Because the amount of the total nuclear RNA which is found in RNA_1 is small (*8*), the possibility exists that the early, high specific activity of this fraction may be the result of contamination. Although this possibility cannot be unequivocally denied, it appears to be unlikely on the basis of the following considerations. (i) At the time that the specific activity of RNA_1 is leveling off (5 to 8 hours), the specific activities of the other fractions are increasing at essentially linear rates. (ii) Agreement between the P found by direct analysis and that found by calculation from ultraviolet absorption is good. (iii) The prior exhaustive extraction of the nucleoli with cold dilute acid and alcohol-ether would remove compounds of low molecular weight which might be expected to contain phosphorus of high specific activity. (iv) When the RNA_1 fraction was submitted to paper electrophoresis, no radioactivity was found which was not associated with regions which were identified as nucleotides.

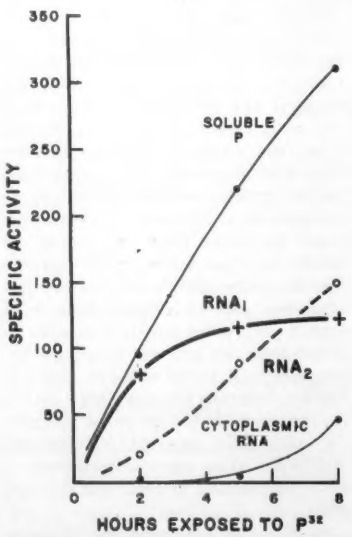


Fig. 1. Specific activity of various fractions of starfish oocytes calculated as counts per second per milligram of phosphorus.

The changes in specific activity with time of the RNA_1 fraction suggest, therefore, that this is a small, very active compartment which is saturated with labeled precursor in 5 hours. After this time, the radiophosphorus which is being incorporated into this pool must be disbursed as rapidly as it is incorporated. Two suggestions can be made about the fate of this material at this time: (i) it acts as a precursor for the RNA_2 fraction; and (ii) it is used in some other site in the cells. These alternatives are the subject of current investigations.

The experiments reported here serve to complement the earlier suggestions (*9*) that nuclear RNA must contain at least two populations of molecules which differ in their metabolic properties (*10*).

W. S. VINCENT

Department of Anatomy, Upstate Medical Center, State University of New York, Syracuse, and *Marine Biological Laboratory, Woods Hole, Massachusetts*

References and Notes

1. J. Brachet, *Nature* **175**, 851 (1955); L. Goldstein and W. Plaut, *Proc. Natl. Acad. Sci. U.S.* **41**, 784 (1955); K. Lark and O. Maaloe, *Biochim. et Biophys. Acta* **21**, 448 (1956); W. S. Vincent, in *The Beginnings of Embryonic Development*, C. Metz, A. Tyler, R. C. von Borstel, Eds. (AAAS, Washington, D.C., in press).
2. R. S. M. Smellie, in *The Nucleic Acids*, E. Chargaff and J. N. Davidson, Eds. (Academic Press, New York, 1955), vol. 2, pp. 393–434.
3. B. Magasanik, *ibid.*, pp. 373–407.
4. A more complete analysis of the theoretical aspects of the interrelationships between nuclear and cytoplasmic RNA will appear in a paper by M. Ycas [*Proceedings of the Oak Ridge Conference on Applications of Information Theory to Radiobiology and Medicine* (Pergamon Press, New York, in press)].
5. The isolation procedure was modified from the technique of Schneider and Petermann [R. M. Schneider and M. L. Petermann, *Cancer Research* **10**, 751 (1950)]. I am indebted to Alfred Marshak for his suggestions in using this medium for the isolation of oocyte nucleoli. (i) Ovaries were removed from starfish, rinsed in filtered sea water, and

then in 0.25*M* sucrose in deionized water made to 0.0018*M* with $CaCl_2$ (Ca-sucrose solution). The ovaries were allowed to stand for 20 min in 5 volumes of the Ca-sucrose, drained and homogenized in a Waring Blendor at slow speed (35 v) for 1 min in 4 volumes of Ca-sucrose. Four drops of caprylic alcohol were added to break the very stiff foam. (ii) The homogenate was filtered through two, and then four layers of coarse cheesecloth (20 by 30 mesh). The filters were washed with Ca-sucrose, and the washings were added to the filtrate to make 700 ml. The filtrate was centrifuged for 5 min at 150 *g* in 100-ml Lusteroid centrifuge tubes. (iii) The supernatant was discarded or saved for the isolation of cytoplasmic fractions, and the precipitate was resuspended in Ca-sucrose and filtered through eight layers of 40- by 40-mesh cheesecloth. The filtrate and washings were made up to 400-ml volume and centrifuged for 5 min at 150 *g*. (iv) The supernatant was discarded, and the precipitate was resuspended in 400 ml of 0.34*M* sucrose in ion-free water and centrifuged for 5 min at 150 *g*. The supernatant was discarded, and the precipitates were combined, made up to 100-ml volume with 0.34*M* sucrose solution, and centrifuged for 5 min at 150 *g*. (v) The supernatant was discarded, and the precipitate made up to 15-ml volume with 0.34*M* sucrose, then the nucleoli were concentrated, and the final contaminants were removed as described by Vincent (*6*). For nucleic acid and phosphorus studies, the sucrose was removed from the final pellet by two washes each in 70 percent, 95 percent, and absolute alcohol. The washed nucleoli were then vacuum dried and stored at −20°C until used. All procedures were carried out at 2° to 4°C. The average time for isolation was 2 hours. The average yield has been about 1 mg of dry nucleoli from 10 g (wet weight) of ovaries.

6. W. S. Vincent, *Proc. Natl. Acad. Sci. U.S.* 38, 139 (1952).
7. J. Wiame, *Biochim. et Biophys. Acta* 1, 234 (1947).
8. In the experiments described here, the RNA, fraction averaged 4.9 percent of the total RNA of the nucleolus.
9. W. S. Vincent, *Intern. Rev. Cytol.* 4, 269 (1955). While this report was being prepared, essentially similar observations on the nuclei of rabbit liver were reported by R. Logan and J. N. Davidson [*Biochim. et Biophys. Acta* 24, 196 (1957)].

10. These studies were supported in part by AEC grant AT(30-1)1343.

9 May 1957

Homing in Bats

Homing ability has been demonstrated in a variety of terrestrial vertebrates. Of the many theories advanced for explaining the sensory basis of this phenomenon, only sun compass orientation has survived critical experimentation (*1*). The navigational problems of homing generally involve more than compass orientation, however (*2*). Matthews (*3*) has proposed a complete celestial navigation theory, based on vision, for certain birds, but others have questioned his interpretations (*2, 4*). Lindenlaub (*5*) has recently demonstrated definite homing tendencies in mice in an apparatus which eliminated any possibility of visual or olfactory clues.

A survey of the literature on homing in bats is given by Cockrum (*6*). Past work has consisted largely of displacing bats from a cave and then attempting to find them in the intricacies of the cave some days, or even months, later. This technique has yielded little information on the homing speeds or the percentage of bats that returned. In 1954 Cockrum released 68 bats (*Myotis velifer*) 28 mi from a cave in Arizona and recaptured two of these as they left the cave the following evening. On the assumption that these bats did not fly during the daytime, it appears that they must have traveled these 28 mi in something less than 4 hours.

Table 1. Homing performance of displaced bats.

Distance (mi)	Number released	Percentage that returned at speed (mi/hr) indicated*					
		> 15	10–15	7–10	5–7	< 5	lost†
			Experiment A, 20–21 Oct.				
5	59			3.4	6.8	33.9	55.9
10	58			1.7	13.8	25.9	58.6
15	57			3.5	17.5	7	71.9
20	60		1.7	6.7	8.3		83.3
			Experiment B, 23–24 Oct.				
30	50	4	2	12	10	8	64
40	50		8	8	6		78
50	50			4	4		92
60	50	2	2	2			94
			Experiment C, 23–24 Oct.				
Blindfolded	25‡		7.2	21.6	21.6	21.6	28.1
Controls	25		12	32	8	12	36

* The figures in the last two columns of experiment A and in the last three columns of experiment B were variously influenced by inequalities in the time that was available for returning before the termination of the experiment. Therefore, they should not be used in comparing the performances of the various distance-groups.

† Netting was terminated at dawn on the first night. Any animals that did not return on the first night were designated lost.

‡ Of the 25 blindfolded bats that were released, 18 were recovered at the mine entrance, and, of these, eight had scratched the covering from one or both eyes. Figures in the table are based on the ten bats which were still blindfolded on their return, multiplied by a factor of 25/18 to render the figures directly comparable with the return percentages of the other experiments.

During the fall of 1956 we performed a few simple homing experiments with bats which revealed a remarkably accurate navigational ability, even in blindfolded individuals (*7*). A total of 484 bats were removed from their hibernating roosts in an inactive lead mine in southwestern Wisconsin during the early hours of darkness on the nights of 20–21 and 23–24 October and transported to the east to points at distances that varied between 5 and 60 mi, for release. Distinctive markings were painted on the wings of the animals for each release point, and the animals were grouped in carrying cages for transport; all had fully recovered from the torpor of hibernation before release. Recaptures were made in a modified Japanese mist net as the bats entered the mine, and the exact time of each arrival was noted.

Homing performance was measured in terms of (i) the percentage of bats that returned to the mine during the same night, and (ii) the over-all homing speed of these returning animals, from the time of release to the time of entering the mine. Return records were obtained for all releases and percentages ranged from 6 percent in the 60-mi group to 72 percent in one of the 5-mi groups (Table 1). Homing speeds ranged up to 19 mi/hr and exceeded 10 mi/hr in 14 cases. Light tail-winds favored most of these animals (*8*), but the performance is regarded as indicating a rapid orientation and a direct homeward course, since flight speeds for bats of this genus have been measured as only 10 to 11 mi/hr (*9*).

Although vision is poorly developed in bats (*10*), its demonstrated importance for distance orientation in other animals indicated that a blindfolding experiment should be performed. Accordingly, 25 bats, blindfolded with eye caps of lampblack in collodion, were released, together with 25 controls, at a point 5 mi east of the mine. Although some of the blindfolded animals had scatched away all or part of their masks before reaching home, others retained theirs, and the fact that they reached home as rapidly as the controls did demonstrated that obstruction of vision had no gross effect on homing performance (Table 1C).

Since bats are able to detect obstacles in their flight path by echolocation (*10*), it is interesting to speculate on the possibility that they are aided by auditory mechanisms in distance orientation. Bats are also capable of learning landmarks and complex spatial patterns within a room by auditory means (*11*), and it is possible that whole landscapes may be memorized. However, evidence presented by Griffin (*12*) and Möhres (*13*) suggests that the maximum effective distance of echolocation for bats of this genus is less than 10 m, and it is difficult

to believe that an animal with these sensory restrictions could attain an "auditory familiarity" with an area of 50 or 60 miles' radius.

Our preliminary experiments thus indicate that bats possess a well-developed ability to orient and to home over long distances by sensory means other than vision. Audition has not been eliminated as a possible mechanism, but it appears to hold little promise of providing a complete answer. Further studies are in progress.

H. C. MUELLER
J. T. EMLEN, JR.
Department of Zoology,
University of Wisconsin, Madison

References and Notes

1. D. Griffin, in *Recent Advances in Avian Biology*, A. Wolfson, Ed. (Univ. of Illinois Press, Urbana, 1955).
2. G. Kramer, *J. Ornithol.* **96**, 173 (1955).
3. G. V. T. Matthews, *Bird Navigation* (Cambridge Univ. Press, London, 1955).
4. K. Rawson and A. Rawson, *J. Ornithol.* **96**, 168 (1955).
5. E. Lindenlaub, *Z. Tierpsychol.* **12**, 452 (1955).
6. E. L. Cockrum, *J. Mammal.* **37**, 48 (1956).
7. The following species were used in these experiments: 470 *Myotis lucifugus*, 12 *Pipistrellus subflavus*, and two *Eptesicus fuscus*. All returns were *Myotis lucifugus*.
8. 20–21 Oct.: wind, 0 to 6 mi/hr, east; temperature, 45° to 64°F. 23–24 Oct.: wind, 6 to 12 mi/hr, east; temperature, 34° to 54°F.
9. D. Griffin, *Natl. Geograph. Mag.* **90**, 117 (1946); E. Gould, *J. Mammal.* **36**, 399 (1955).
10. D. Griffin and R. Galambos, *J. Exptl. Zool.* **86**, 481 (1941).
11. F. P. Möhres and T. zu Oettingen-Spielberg, *Verhandl. deut. Zool.* **14**, 248 (1949).
12. D. R. Griffin, *J. Exptl. Zool.* **123**, 435 (1953).
13. F. P. Möhres, *Z. vergl. Physiol.* **34**, 547 (1953).

25 April 1957

Ethylenediaminetetraacetate and Mitochondrial Adenosine Triphosphatase Activity

The adenosine triphosphatase activity of isolated mitochondria is variable and is influenced by many factors (*1, 2*). We have observed, as is shown in Table 1, (*3*), that the inclusion of ethylenediaminetetraacetate in the sucrose used for tissue homogenization results in marked changes in the adenosine triphosphatase activity of mitochondria isolated from these homogenates.

Mitochondria were isolated from 0.25*M* sucrose homogenates with and without ethylenediaminetetraacetate, 0.01*M*, *p*H 7.4 (*4*). After 10 minutes' centrifugation at 600*g*, the supernatant solution was centrifuged for 10 minutes at 8500*g* to sediment the mitochondria. The particles were then resuspended in sucrose of the same composition as that used for homogenization and, after resedimenting, were suspended in sucrose without ethylenediaminetetraacetate. All operations were performed at 2°C. Adenosine triphosphatase activity was measured using a 10-minute incubation at room temperature in a volume of 1 ml containing, in micromoles, the following: adenosine triphosphate (Pabst), 8; $MgCl_2$, 4; tris(hydroxymethyl)aminomethane hydrochloride (*p*H 7.4), 20; and sucrose, 176. Reactions were initiated by addition of mitochondria and were terminated by addition of 0.02 ml of 70-percent perchloric acid. These solutions were immediately cooled to 0°C. Inorganic phosphate was determined by the Fiske-Subbarow procedure (*5*) on an aliquot of the supernatant solution.

Table 1. Adenosine triphosphatase activity of mitochondria isloated from sucrose and sucrose-ethylenediaminetetraacetate (EDTA) homogenates. Adenosine triphosphatase was measured at two enzyme concentrations ranging from 40 to 200 μg of protein N. Activities are expressed as micromoles of phosphate hydrolyzed per 10 minutes, per milligram of mitochondrial nitrogen at room temperature. Average activity values are reported except for two cases where wide variation in the ratio, activity/enzyme concentration, occurred. This may result from inhibition of the adenosine triphosphatase by accumulated adenosine diphosphate, for addition of the latter to the incubation mixture yields a marked inhibition of the adenosine triphosphatase (*8*).

Source of mitochondria	EDTA added	Δ Inorganic phosphate (μmole)			
		Fresh mitochondria		Aged mitochondria (30 min, 38°C)	
		No addition	Dinitrophenol added ($2.5 \times 10^{-4}M$)	No addition	Dinitrophenol added ($2.5 \times 10^{-4}M$)
Rat liver					
1	−	0.6	9.6	6.3	9.0
1	+	1.3	6.6	1.4	1.6
2	−	0.3	12.2	6.9	
3	+	3.4	3.7	2.4*	
Rabbit heart					
1	−	10.1	21.9	5.2	6.3
1	+	15.3	(33.0, 23.4)†	18.4	19.1
2	−	2.7	8.3	1.7	2.1
3	+	8.7	(18.8, 10.3)†	7.7	11.5

* Aged 2 hours at room temperature. † Values were not averaged because of large variation in activity with variation in the amount of mitochondria added.

When ethylenediaminetetraacetate is used, the supernatant solution from the mitochondrial pellet is redder and the final mitochondrial suspension is more cream-colored than when sucrose alone is used for homogenization. Differences in the adenosine triphosphatase activity are clearly evident even though the final mitochondrial pellet isolated by both procedures is suspended in sucrose without ethylenediaminetetraacetate.

Rat liver mitochondria isolated from sucrose-ethylenediaminetetraacetate homogenates have a higher initial adenosine triphosphatase activity and a lower "latent adenosine triphosphatase" (*1*) activity than do mitochondria isolated from sucrose alone.

The adenosine triphosphatase of rabbit heart mitochondria isolated from sucrose decreases on aging, while that of heart mitochondria isolated from sucrose-ethylenediaminetetraacetate does not. Although the activity of aged preparations may be increased slightly by addition of dinitrophenol, the amount of phosphate released from adenosine triphosphate is below that obtained with fresh preparations in the presence of dinitrophenol.

These data show that isolation of mitochondria in sucrose containing 0.01*M* ethylenediaminetetraacetate alters the adenosine triphosphatase activity pattern from that observed with mitochondria isolated from sucrose alone (*6*). On the other hand, we find that ethylenediaminetetraacetate yields heart muscle mitochondrial suspensions which have a uniformly more dependable oxidative capacity. This is in conformity with reports of other investigators (*4, 7*), who have noted an increased stability of mitochondria that have been isolated in the presence of ethylenediaminetetraacetate.

The data presented here show the marked variation of an enzymic activity that can result from a modification commonly employed in the isolation of mitochondria. While it is well known that the source of mitochondria and the nature of the isolation procedure may modify the enzymatic spectrum of the particles, the effect of a small change in procedure may pass unrecognized in many instances. When the rate of adenosine triphosphate turnover is an important factor, these changes may assume a primary significance.

R. W. VON KORFF*
Department of Pediatrics,
Variety Club Heart Hospital,
University of Minnesota, Minneapolis

References and Notes

1. W. W. Kielley and R. K. Kielley, *J. Biol. Chem.* 191, 485 (1951); H. A. Lardy and H. Wellman, *ibid.* 201, 357 (1953); V. R. Potter, P. Siekevitz, H. C. Simonson, *ibid.* 205, 893 (1953).
2. M. A. Swanson, *Biochim. et Biophys. Acta* 20, 85 (1956); H. G. Klemperer, *ibid.* 23, 404 (1957); D. K. Meyers and E. C. Slater, *Nature* 179, 363 (1957).
3. This work was supported by grants from the Minnesota Heart Association and the American Heart Association.
4. E. C. Slater and K. W. Cleland, *Biochem. J. (London)* 55, 566 (1953).
5. C. H. Fiske and Y. Subbarow, *J. Biol. Chem.* 66, 375 (1925).
6. M. Gross [*Science* 118, 218 (1953)] has reported an activation of calcium-activated adenosine triphosphatase of mouse heart homogenates by addition of ethylenediaminetetraacetate. Such homogenates contain myosin adenosine triphosphatase as well as mitochondrial adenosine triphosphatase.
7. F. E. Hunter, Jr., and L. Ford, *J. Biol. Chem.* 216, 357 (1955); F. E. Hunter, Jr., J. Davis, L. Carlat, *Biochim. et Biophys. Acta* 20, 237 (1956).
8. The assistance of James Runquist and Robert Kyle with isolation of mitochondria and with analytic determinations is gratefully acknowledged.

* Established investigator of the Minnesota Heart Association.

16 May 1957

Some New Whiskers

Filamentary crystals have been known for many years (*1*), but the recent discovery of spontaneous filamentary growths of several metals by Compton, Mendizza, and Arnold (*2*), and the subsequent observation by Herring and Galt (*3*) that these filamentary growths are many times stronger than massive crystals, have resulted in intensified interest in their growth and properties. Several methods of growing "whiskers" (as these crystals are now called) have been developed. Growth by condensation from vapor (*4*), electrolytic deposition from solution (*5*), and chemical reactions (*6*) have been reported. During the course of a current study of the growth kinetics and physical properties of whiskers, whiskers of palladium, β-manganese, and an intermetallic compound, manganese silicide (Mn_3Si_3), have been obtained. Whiskers of these three materials have not been reported previously.

The palladium whiskers are produced by the thermal decomposition of liquid palladium dichloride at 960°C and are between 1 and 10 mm in length. The β-manganese whiskers, about 0.25 mm long, are grown by the hydrogen reduction of liquid manganous chloride at 940°C in alumina reaction vessels. The salt was distilled prior to reduction to remove moisture and other impurities. The manganese silicide whiskers are formed during the hydrogen reduction of the manganous chloride in the presence of silicon dioxide at 940°C and are also about 0.25 mm long. All these whiskers are in the neighborhood of 2 μ in diameter. The reactions are carried out in gastight refractory tubes through which argon or hydrogen flows at a linear velocity on the order of 1 cm/sec.

Whiskers produced by the thermal decomposition of palladium dichloride nucleate on a substrate consisting of massive crystals of palladium metal. In contrast, the β-manganese whiskers grow at isolated sites on the bare aluminum oxide refractory. Equiaxed crystals are also present in the reaction product. The manganese silicide whiskers grow from the refractory wall and are found immersed in pools of a fused salt that flows over them as they grow. Figure 1 shows some of these whiskers after dissolution of the salt with absolute alcohol. However, it is not certain in this case whether growth takes place from the liquid or from the vapor phase (*7*).

The palladium whiskers occur in the form of seemingly straight rods, corkscrewlike helices, and twisted wires (see Fig. 2). Both right- and left-handed helices are observed. Frequently the pitch of the twist and the diameter of the helix or whisker change gradually along the length, and, often, abrupt changes from straight to helical form occur. The filaments growing as helices are occasionally formed from regularly connected straight segments, as illustrated by the two short helices near the center of Fig. 2. X-ray diffraction data show that the growth axis of the spiral whiskers studied is a <111> crystallographic direction. The axial direction in the straight whiskers is a high index direction varying within 12 deg around the <211> direction (*8*, *9*).

The β-manganese whiskers studied have a <100> growth direction, and the whiskers of manganese silicide, which crystallize in a hexagonal lattice, have been observed with both <10·0> and <00·1> growth directions—that is, with growth directions either perpendicular or parallel to the basal plane.

All the palladium and manganese silicide whiskers tested could be repeatedly bent elastically to at least 2.0-percent strain, while none of the β-manganese specimens could be bent beyond about 1.5-percent elastic strain. The strains observed correspond to failure stresses of between 10^{10} and 10^{11} dy/cm² (1.5×10^5 to 1.5×10^6 lb/in.²). Massive crystals of these materials fail at stresses smaller by several orders of magnitude.

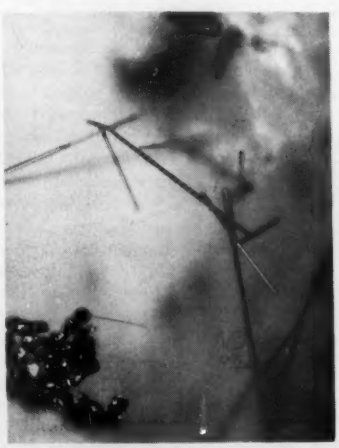


Fig. 1. Cluster of manganese silicide crystals after extraction from the remaining manganous chloride salt with ethyl alcohol. The fine isolated whisker at the lower left is 75 μ long.

Fig. 2. Portion of a cluster of palladium whiskers. Note the helices of slowly varying pitch and the abrupt transitions of pitch. Several helices are composed of connected straight segments. The length shown of the long helix is 0.8 mm.

E. F. Riebling
W. W. Webb

Metals Research Laboratories,
Electro Metallurgical Company
Division of Union Carbide Corporation,
Niagara Falls, New York

References and Notes

1. H. K. Hardy, *Progr. Metal Phys.* 6, 45 (1956).
2. K. G. Compton, A. Mendizza, S. M. Arnold, *Corrosion* 7, 327 (1951).
3. C. Herring and J. K. Galt, *Phys. Rev.* 85, 1060 (1952).
4. G. W. Sears, *Acta Met.* 1, 457 (1953).
5. P. A. van der Meulen and H. V. Lindstrom, *J. Electrochem. Soc.* 103, 390 (1956).
6. S. S. Brenner, *Acta Met.* 4, 62 (1956).
7. A more extensive analysis of the kinetics of whisker growth by chemical reaction is being prepared.
8. The assistance of R. C. Durham in the handling and mechanical testing of the whiskers, of R. D. Dragsdorf in x-ray diffraction observations, and of W. D. Forgeng in photomicrography is gratefully acknowledged.
9. A detailed report of the dislocation configuration in whiskers (including the more complex forms) is in preparation.

31 May 1957

Evidence Concerning the Size of Amino Acid Incorporation Structures in Escherichia coli

Incorporation of exogenous amino acids into *Escherichia coli* has been shown to be at least a two-step process (*1, 2*) designated as incorporation into cold trichloroacetic acid (TCA) soluble fraction (metabolic pool) and incorporation into the trichloroacetic acid-insoluble amino acid fraction. In order to gain information on the functional units responsible for these processes, we have combined the techniques of uptake of radioactive tracers with radiation target analysis (*3*).

The basic protocol of the experiments is to grow *E. coli* on a minimal medium and to study the uptake of C^{14}- and S^{35}-labeled amino acids before and after irradiation with various doses of 1.3-Mev gamma radiation from a cobalt-60 source. The methods of determining incorporation into pool and trichloroacetic acid-insoluble fractions were those developed by the biophysics group at the department of terrestrial magnetism of the Carnegie Institution of Washington (*1, 4*). The results of the radiation inactivations were interpreted on the basis of previously developed target theory (*5, 6*).

Cultures of *E. coli* B were aerated overnight at 37°C in minimal (C) medium (*4*) with 5 g/lit of glucose. During this time, the culture grew to stationary phase; 50 ml of this suspension was then added to 150 ml of fresh medium and allowed to grow at 37°C with aeration for 2 hours. At this time the culture was in log phase, at a concentration of 0.5 to 1.0×10^9 cells per milliliter. Samples of 20 ml each were taken and frozen in Dry Ice. The cultures were kept at Dry-Ice temperatures during irradiation with a kilocurie cobalt-60 source. After irradiation, the samples were thawed and brought to 37°C. Freezing and thawing procedures took 5 to 10 minutes each.

The thawed cultures were added to equal volumes of minimal medium (with glucose) containing a labeled amino acid. Each 20-ml sample was supplied with 0.1 or 0.4 μc of C^{14}-L-leucine (Nuclear Instrument and Chemical Corp., specific activity 7.95 mc/mmole) or 0.2 μc of S^{35}-L-cystine (Abbot Laboratories, specific activity 3.48 mc/mmole).

The bacteria-amino acid incubation mixture was aerated at 37°C. Samples were taken during the first 15 minutes of culture with the labeled amino acid using the techniques of Britten, Roberts, and French (*1*); 2-ml samples were taken from the incubation mixture and drawn through a collodion membrane filter which retained the bacteria. The organisms were then washed with 2 ml of sterile, glucose-containing minimal medium. Other 2-ml samples of the incubation mixture were placed in 2 ml of 10-percent trichloroacetic acid. This was later filtered and then washed with 2 ml of 5-percent trichloroacetic acid. These two procedures produced the "whole-cell" and the "TCA-insoluble" samples. The difference between the whole-cell fraction and the TCA-insoluble fraction was called the "pool." The collodion membrane filters were dried in air and counted under a thin-window (1.4 mg/cm²) Geiger counter for either 4 or 5 minutes.

Control experiments with unfrozen, unirradiated bacteria indicated that the freezing process causes a 15 percent or less change in the rate of uptake of the amino acid, and the final value attained in 15 minutes is independent of the freezing.

The uptake of S^{35}-labeled cystine in the first 15 minutes in the whole-cell and TCA-insoluble fractions is shown in Fig. 1 for an unirradiated frozen sample and for a sample that received 443,000 r. The TCA-insoluble and pool fractions at a given time decrease exponentially with dose, as is shown in Fig. 2 for the fractions after 14 minutes' incubation. If the decrease is characterized by the dose required to reduce the size of a fraction to 37 percent of the control, it is found that the 37-percent doses for the incorporation of a given amino acid are the same to within ± 10 percent for all times of incorporation.

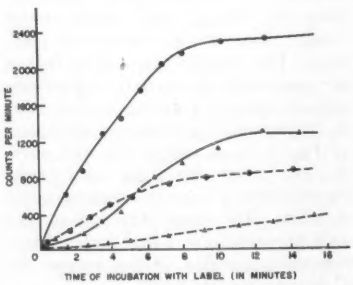


Fig. 1. Typical uptake of S^{35} cystine into *Escherichia coli*. Background was 15.2 ± 0.7 count/min and has been subtracted. Solid circles, whole cell; solid triangles, TCA-insoluble fraction; solid curve, no irradiation; broken curve, 443,000 r.

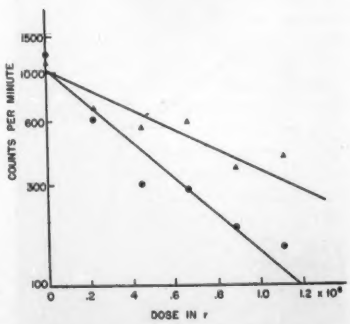


Fig. 2. Decrease in cystine incorporation with radiation dose. Bacteria were cultured with cystine for 14 minutes. Background was 15.2 ± 0.7 count/min and has been subtracted. Solid triangles, pool; solid circles, TCA-insoluble fraction.

Since 86 percent of the incorporated leucine and 63 percent of the incorporated cystine go into trichloroacetic acid-precipitable protein, while less than 0.3 percent of the leucine and only 2.8 percent of the cystine go into nucleic acids (*4*) (which may also be brought down by cold trichloroacetic acid), the use of the TCA-insoluble fraction as the measure of labeled protein is valid to a good approximation.

Considerations of target theory (*5*) indicate that the functional units involved with the pool and the protein formation are large. The average doses required to reduce incorporation to 37 percent of controls, and the apparent target volumes calculated from these, are as follows: cystine pool, 9.8×10^5 r and 2.0×10^{-18} cm³; cystine TCA insoluble, 4.5×10^5 r and 4.4×10^{-18} cm³; leucine pool, 2.2×10^5 r and 8.9×10^{-18} cm³; leucine TCA insoluble, 3.6×10^5 r and 5.4×10^{-18} cm³.

Any radicals formed can diffuse only very short (less than 30A) distances (*6*). Since, under the conditions of irradiation, freely diffusing radicals cannot play a dominating role in the inactivation process, the apparent inactivation volume is of the same order of magnitude as the actual physical structure involved in amino acid uptake. Although there are many complicating factors involved in obtaining physical dimensions from radiation inactivation volumes, these data strongly indicate that the physical structures involved have molecular weights between 1 and 10 million. If such a unit were spherical, the diameter would be 150 to 300 A.

FRANKLIN HUTCHINSON
HAROLD MOROWITZ
ELLIS KEMPNER

Biophysics Department, Yale University, New Haven, Connecticut

References and Notes

1. R. J. Britten, R. B. Roberts, E. F. French, *Proc. Natl. Acad. Sci. U.S.* 41, 863 (1955).
2. G. N. Cohen and H. V. Rickenberg, *Compt. rend.* 240, 2086 (1955).

3. This work was aided by a grant from the John A. Hartford Foundation.

4. R. B. Roberts *et al.*, *Carnegie Inst. Wash. Publ. No. 607* (1955).
5. E. C. Pollard *et al.*, *Progr. Biophys. and Biophys. Chem.* 5, 72 (1955).
6. F. Hutchinson, *Radiation Research*, in press.

28 May 1957

Book Reviews

The Prospects of Nuclear Power and Technology. Gerald Wendt. Van Nostrand, Princeton, N.J., 1957. 348 pp. $6.

The United Nations Conference on the Peaceful Uses of Atomic Energy, which was held in Geneva in 1955, viewed the world energy situation with unprecedented breadth of outlook and completeness. Representatives of the United Nations submitted papers which described the energy situation in the world and which projected energy demands into the distant future. Representatives of individual nations described these situations with respect to energy resources in their own countries and attempted to evaluate the potential applicability of atomic energy. Representatives of the nations which possess the more highly developed nuclear technologies described, in some detail, their programs for the development of this new source of energy.

In *The Prospects of Nuclear Power and Technology,* Gerald Wendt has done an excellent job of abstracting the lengthy reports of this very unusual conference and of putting them in a form which should be readable and interesting to scientist and nonscientist alike. Unlike many popularizers of science, Wendt appreciates the realities of both the economics and the technology of nuclear energy, with the result that he does not give the reader the view that atomic energy is going to revolutionize his life overnight. At the same time he correctly emphasizes the fact that, in the long run, atomic energy will be essential to the survival of civilization and that the time is close at hand when it will be essential to the survival of certain specific energy-short areas of the world—for example, Japan.

Wendt discusses briefly, simply, and completely the technical aspects of producing nuclear power. He then discusses in some detail the energy needs of the world, giving special emphasis to the special problems of countries such as India and Japan, in contrast to those of Great Britain and the United States. This discussion is followed by detailed accounts of the applicability of atomic energy in many specific areas of the world, with particular emphasis on the economic factors that are involved.

The second part of the book, representing about half of the total, is devoted entirely to a discussion of the technological aspects of the problems involved in the production of nuclear power. What is the situation with respect to mineral resources? How are nuclear fuels and reactor materials produced? How do nuclear reactors work? What are the problems of waste disposal? All of these questions are discussed in detail, clearly, yet with no "talking down" to the reader.

Those of us who are asked from time to time to recommend, to nonscientists, reading matter concerned with the peaceful uses of atomic energy should be grateful to Gerald Wendt for having written this book. I, for one, will recommend it highly and will urge my colleagues to do likewise.

HARRISON BROWN
California Institute of Technology

Faune de France. 60, Bryozoaires. Part I. *Entoproctes, Phylactolèmes, Cténostomes.* Marcel Prenant and Geneviève Bobin. Lechevalier, Paris, 1956. 398 pp. Illus. F. 5000, paper.

No single up-to-date monograph exists which is completely adequate for identification of recent bryozoan fauna of Western Europe, particularly of France and the Mediterranean region. Marcel Prenant and Geneviève Bobin intend to alleviate the need but, because bryozoan literature is considerable and taxonomy is controversial, they find it necessary to extend the project beyond one volume.

The first volume covers 25 families, 40 genera, and 119 species, 11 of which are fresh-water species and 108, marine. These 119 species fall into the following taxa: class Entoprocta, 38 species: class Ectoprocta: subclass Phylactolaemata, nine species; subclass Gymnolaemata, suborder Ctenostomata, 72 species. Of these 119 species, 77 are already known in French waters and 35 more can be expected to occur there. Of these 77 reported species, 25 are entoprocts, eight, phylactolaemata, and 44, ctenostomes.

Subsequent volumes will deal with the remaining and far more numerous marine ectoprocts of the suborders Cheilostomata and Cyclostomata.

No new species are erected. Deviations from traditional bryozoan classification are minor. Only one emendation was made, that to the ctenostome group Paludicellina, into which were placed the Benedeniporidae and the Lobiancoporidae, which the authors have elevated to family rank from previous subfamily status. Other authors had considered these subfamilies as belonging to the Alcyonidiidae. Complete synonymy and morphological, statistical, developmental, ecological, distributional, and historical data are given for each species, wherever such data are available or wherever it is prudent.

Of the monograph's 398 pages, 57 are devoted to an extensive bibliography, about 28 pages, roughly, to very detailed keys to genera and species, 49 pages to the Phylactolaemata, 161 pages to the ctenostomes, and 102 to the entoprocts. The 11 fresh-water species occupy about 59 pages.

The illustrations (151 figures) are simple, large, clear, and adequate for purposes of identification. Each of the 119 species is illustrated. Most of the figures include several sketches each, and 39 are full plate size, or nearly so.

The classification that is followed is conservative and traditional—that of Marcus and of most other established bryozoologists—and is at variance with classifications proposed by Cori, Hyman, and others who separate the entoprocts from the Bryozoa.

The increasing interest in the Bryozoa makes such a species compendium necessary.

MARY DORA ROGICK
College of New Rochelle

Vapour Phase Chromatography. Proceedings of the symposium sponsored by the Hydrocarbon Research Group of the Institute of Petroleum, London, 30 May–1 June 1956. D. H. Desty, Ed. Academic Press, New York; Butterworths, London, 1957. 436 pp. Illus. $12.

Vapour Phase Chromatography is the proceedings of the symposium sponsored by the Hydrocarbon Research Group of the Institute of Petroleum, held in London 30 May–1 June 1956. It comprises 36 contributions on a wide variety of researches in gas chromatography, all by well-qualified authors. Nearly all of the

contributions are of high quality, and much new information is presented. Most of the papers originated in laboratories in the United Kingdom, but a few present work conducted in the Netherlands, Canada, the United States, France, Czechoslovakia, New Zealand, and Hungary. Fundamental aspects of gas chromatography, including thermodynamic treatment, and factors affecting efficiency and choice of solvents are the main themes in six of the papers. Another half-dozen papers are devoted to experimental evaluation of new supports, liquid phases, detectors, and the like.

Operation of columns at high temperatures has been very effective in extending the scope of gas chromatography to separation of mixtures of high-boiling compounds. Two papers on this subject are included. Other papers describe experimental work dealing with continuous large-scale (semiworks) separation of nearly pure acetylene from partially burned methane, use of the process to study kinetics of reactions, separation of the isotopic modifications of hydrogen, control of refinery processes, separation of fatty acids and alcohols, chlorinated and fluorinated compounds, and determination of isopropyl nitrate in heavy oil. Two papers review the relative merits of the several methods of detection, another describes use of a gas-density balance for detection, and two are concerned with the hydrogen-flare detector.

Much useful information appears in the prepared and extemporaneous discussions. Included are descriptions of a new pipette for sample introduction, separation of alkylated diphenyls, and improvements in the use of a hydrogen-flare detector.

I found an extraordinarily small number of typographic errors. The illustrations are uniformly good, and the printing is clean and sharp. Good quality coated paper was used, and the book is sturdily bound.

This volume can hardly be classified as simply a textbook on gas chromatography. It is an excellent presentation of recent researches in the field, at several prominent laboratories.

FRANK L. HOWARD
National Bureau of Standards

Handbuch der Physik. vol. XX, *Electrical Conductivity II.* S. Flügge, Ed. Springer, Berlin, 1957. 491 pp. Illus. DM. 112.

Volume XX of the *Handbuch der Physik* deals with electric conductivity in semiconductors, in ionic crystals, in glasses, and during electrolysis in liquids. The subjects dealt with are very different, but, in general, the articles are well written and give an excellent account of the present status of the field described.

The article on semiconductors, by O. Madelung, is the longest (245 pages) and the most complex. It is well organized and well written. The article is good in that it is self-contained; for example, the behavior of semiconductors having isotropic Fermi surfaces and under conditions of isotropic electron scattering is considered first. Then the situation which occurs when the constant energy surfaces are anisotropic and the scattering is anisotropic are considered. Similarly, one first considers problems in which the electron and the hole distributions are in local equilibrium and only later are problems considered in which local deviations from the equilibrium state are important. There is, however, one section which I believe is out of its proper place. The article ends with a section on special semiconductors. In many ways this would be useful at the beginning, since one would then see, at the beginning, that many semiconductors—in fact, probably most—have a rather complicated band structure for an understanding of which the complex treatment given for conductivity is useful and indeed necessary. The literature cited is very completely surveyed through 1955, and references for the first few months in 1956 are given. The discussion of the various subjects is, in general, full and careful, and all possible subjects are considered. The description of the cyclotron resonance experiments is perhaps a bit brief, but the references are complete. This review appears at a good time, since one has the feeling that most of the important phenomena in the field are at least qualitatively understood.

The second article, by A. B. Lidiard, is an excellent survey of the present status of ionic conductivity. The article gives careful theoretical consideration to the types of defect which are responsible for ionic conductivity in the alkali halides and the silver halides. If one compares the article with the book of Mott and Gurney (*Electronic Processes in Ionic Crystals,* Oxford University Press, 1940) it is clear, first, that the theoretical calculations in the field have been carried a good deal further, in a quantitative sense, than they had been before World War II; in addition, certain phenomena are discussed and treated theoretically which were not considered before the war; for example, the alternating-current phenomena and the deviations from the Einstein relation connecting the ionic conductivity and the diffusion constants. It is also clear that the quantity and quality of experimental data have increased greatly, so that the improved theoretical treatment is justified. The description of all these changes is given by Lidiard in a very clear and concise fashion. The article confines itself mainly to the alkali halides and the silver halides, whereas a brief mention of the extent of the present knowledge concerning other materials, such as oxides and sulfides, would be welcome. The article is carefully and clearly written and will be useful both for those who have followed recent developments and for the uninitiated.

The third article, by J. M. Stevels, is on the electric properties of glass; both the direct- and alternating-current properties are described. It is clear that in this field, in contrast to the two cases considered in preceding paragraphs, the theoretical development is at a very early stage. The experimental situation is clearly presented, and various qualitative ideas concerning interpretation are discussed.

The last article, by E. Darmois, is a survey of electrochemistry. It considers the phenomena which occur in electrolytic solutions. The major new developments in this field since 1935 are the development of polarographic analysis, by Heyrovsky, and the increasing use of electrolytic polishing and etching. These developments are rather briefly discussed.

J. S. KOEHLER
Cavendish Laboratory,
Cambridge University

The Theory of Groups. vols. 1 and 2. A. G. Kurosh. Chelsea, New York, 1955. 272 pp.; 308 pp. $4.95 per volume.

The Theory of Groups (in two volumes) is a translation by K. A. Hirsch of the second Russian edition of *Teoriya Grupp.* A German translation of the first edition was published in 1953 by the Akademie-Verlag, Berlin. However, the second edition differs so much from the first that it is virtually a new book.

The theory of groups is one of the most active areas of modern mathematical research, and an up-to-date textbook has been needed for some time. This book fulfills that purpose admirably. Approximately one-quarter of the book deals with the elements of the subject and does this from the modern point of view, without unnecessary assumptions of finiteness. In fact, the theory of finite groups is deliberately omitted from the whole book, and the author mentions the need for a separate textbook on the subject. The translation is excellent, and the translator has added many useful appendixes in addition to extending the bibliography to include relevant research work of the last few years.

Each volume is in two parts. Part I of volume I consists of chapters I, II,

III, IV, and V and covers the fundamentals of group theory: homomorphisms, normal subgroups, groups with operations, series of subgroups, direct products, and so forth. The elements of free groups and defining relations are treated in chapter V.

Part II in volume I consists of chapters VI, VII, and VIII and deals with the theory of abelian groups. Chapter VI is concerned mainly with free abelian groups and finitely generated abelian groups and gives the usual structure theory. Ulm's theorem, characterizing countable periodic abelian groups, is given in that chapter, and chapter VIII contains a discussion of torsion-free abelian groups, including the work of Baer and others.

Chapters IX and X, in part III, go into the deeper properties of free groups, free products, and groups given by generators and relations. The structure of subgroups of free groups, and of free products, is discussed in chapter IX. Part of chapter X is devoted to the recent work of B. H. Neumann, H. Neumann, and G. Higman, including the theorem that every countable group can be embedded in a two-generator group. The remainder of part III (chapters XI and XII) deals with lattice-theoretic methods in group theory, direct decompositions, group extensions, and an introduction to the Eilenberg-MacLane cohomology theory for groups.

In part IV (chapters XIII, XIV, and XV) there is a detailed account of recent work, much of it by Soviet mathematicians, in the theory of solvable and nilpotent groups.

TREVOR EVANS
Emory University

Scientific Inference. Harold Jeffreys. Cambridge University Press, New York, rev. ed. 2, 1957. 236 pp. $4.75.

This is a fascinating book and, also, a valuable contribution to fundamental research. That should be sufficient praise for any review, but let me make the judgment plausible. This is virtually a new book, by comparison with the first editions (1931, 1937). It is by the author of the monumental *Theory of Probability*, the masterly *Methods of Mathematical Physics*, and an incisive geophysical study, *The Earth*. No one who is familiar with these works would expect less than great analytical ability and a remarkable range of knowledge, but even such a reader would still be greatly impressed. The main purpose of the present volume is to show that scientific method can be understood only by way of an understanding of probability; but, in the course of this enterprise, we find substantial discussions of transfinite arithmetic and the foundations of mathematics, including the Gödel theorem, biological classification, dimensional analysis, Newtonian dynamics, the history of astronomy, relativity, quantum theory, Euclidean geometry as a mensurational theory, and numerous philosophical problems (for example, solipsism and determinism).

It will be seen that the 231 pages of text are at a level quite unlike that of any ordinary category of book on the American market. They cut across academic boundaries, but not in the sense of any "general survey." This is a postdoctoral interdisciplinary course, marked by considerable originality and great common sense.

It is worth adding some specific comments. I do not consider satisfactory the suggestion (page 21) that the barber paradox is self-contradictorily formulated whereas the liar paradox is not. In each case, the paradox arises on examination of an apparently consistent assertion. The suggestion that scientists know more about causality than philosophers do (pages 12, 60) is surely only superficially plausible, like the idea that linguists "must" know about linguistics. Scientists are suckers for the hoariest philosophic eccentricities [as Jeffreys ably demonstrates in the cases of Eddington (page 223), Born (page 221), and von Mises (page 81)], just as philosophers are sometimes suckers for the latest scientific craze. A man with eyes all 'round his head probably would not know which way to go.

A good many of the early developments of probability theorems (Chapter 2) are open to serious difficulties, owing to Jeffreys' use of the propositional calculus notations with their well-known peculiarities. For example, the idea that a contradiction implies "every proposition in the language" (page 27) (derived from the *Principia Mathematica* notation) forces Jeffreys to introduce a requirement of consistency on the data. He defends this by saying, "In science we are not interested in inferences from self-contradictory data" (*ibid.*). But we are; reductio ad absurdum proofs are crucial in mathematics and have an obvious analog in identifying faulty instruments and hypotheses. Besides, the thesis that *any* proposition follows from a contradiction is surely very extreme, and certainly avoidable [we can retain $(p \rightarrow \sim p) \rightarrow \sim p$ and reject $(p \sim p) \rightarrow q$, although at some cost in systematic simplicity].

Some modern analytical philosophers will be made uneasy by various remarks —for example, that a hypothesis *entails* (rather than implies) observable consequences (page 34); that conventions could produce reasons (page 39); that a wavelength definition of "red" would make the red sensation useless as an indicator (page 172); that entropy directly measures the passage of time (page 173); and that psychoanalytic insight cures neuroses (page 195). But it is hard to imagine a reader of this book who will not be greatly stimulated and educated. Its pedagogical message alone is indisputable and valuable—specifically, that a scientist who is untrained in statistics is seriously handicapped and, generally, that the boundaries of subject matter are barriers to creation.

MICHAEL SCRIVEN
Swarthmore College

A Symposium on the Chemical Basis of Heredity. Sponsored by the McCollum-Pratt Institute of Johns Hopkins University with support from the A.E.C. W. D. McElroy and Bentley Glass, Eds. Johns Hopkins Press, Baltimore, Md., 1957. 834 pp. $12.50.

Probably no field in modern biology is of more fundamental significance and interest, is more intriguing and exciting to the imagination, is more rapidly developing, and involves the application and integration of more varied disciplines than is the subject of this symposium volume, the chemical basis of heredity. The major chapters—"Cellular units of heredity," "Role of the nucleus, nucleic acids and associated structures in cell division and protein synthesis," "Nucleic acids as transforming agents," "Viruses as bearers of heritable characteristics," "Nucleic acids, chemical composition and structure," "Synthesis of nucleotides and nucleic acids," "Mechanism of duplication"—include presentations and interpretations of the latest experimental results by most of the leaders in each of the many and varied fields represented. The discussions following each section are perhaps even more valuable and interesting than the formal papers.

Although major questions, such as the detailed structure of genetic units, the mechanism of information coding, transfer, and expression, the molecular basis of mutation, and the mechanism of duplication of genetic material, cannot as yet be answered definitively, they are carefully analyzed and evaluated in illuminating detail. These analyses include the clarifying introduction of useful new terms and definitions, such as the *recon* (smallest genetic recombination unit), the *muton* (smallest genetic unit susceptible to mutation), and the *cistron* (smallest functional genetic unit); the classification of genetic replication schemes into "conservative," "semi-conservative," and "dispersive"; and the classification of recombination mecha-

nisms into "fragmenting" and "non-fragmenting."

The 834 pages cover too wide a scope of subjects even to list here by topics or authors, as is evidenced by the admirable 77-page summary (chapter VIII), which shows, to paraphrase, "as in a Glass, [not so] darkly, the shapes of things to come." Altogether, this fascinating volume is a "must" for all biologists, whether biochemically or genetically orientated, and whether their interests are specific or general.

E. L. TATUM

Rockefeller Institute for Medical Research

Professional Amateur. The biography of Charles Franklin Kettering. T. A. Boyd. Dutton, New York, 1957. xii + 242 pp. Illus. $4.50.

He who reads *Professional Amateur* unconsciously recalls two other inventive Americans who ministered to their country's industrial advance—Franklin and Edison. Charles Franklin Kettering more closely resembles the former in his wide and general concern, which even verges on the philosophical, but is more like Edison in that he gears his endeavors to the practical developments of which his time has need.

For dollar-minded readers, this is truly an American success story. For Kettering, the reward was principally reckoned by other standards. His start was in a farm home and a country school, with a very bothersome handicap—poor eyes—that delayed his graduation from college until his 28th year. After graduation from Ohio State University's College of Engineering, he was employed by the National Cash Register Company. There, in 5 years, he guided the production of three major improvements in their machines. In that period he also developed a program of private research which, by 1909, prompted his withdrawal from the laboratory of the National Cash Register Company. In the 10 years that followed, he and his associates improved automobile ignition, developed and set up a factory for the Delco Lighting System, demonstrated the virtues of high-octane gasoline, and put a self-starter on the Cadillac automobile. In 1919, he accepted, with some reservations, the headship of the newly established General Motors Research Laboratory. From that laboratory, during the 27 years of his direction, came "ethyl" gasoline, new finishes for quick car-painting, a new, efficient diesel engine for use in marine and rail service, and a high-compression automobile engine, ready for production.

His marginal activities during these years included a share in the study of heat for medical therapy, the production of a pilotless plane for use in World War I, and a part in the planning and financing of an institute for cancer research. His response, even though reluctant, to a call for help is credited with "saving the Winters National Bank of Dayton [Ohio] from collapse" in 1924. It was his own initiative, however, that put him in business with a home-town (Loudonville, Ohio) concern in order "to elevate living conditions and general prosperity of the people of the town." The success of this venture was, in dollars, about 30 times greater than he had expected.

Kettering retired in 1947. Since that time he has been almost as active as before. Four interests claim his attention—cancer research, photosynthesis, magnetism, and the design of better and less expensive light airplanes. In pursuit of the last, he has resumed flying and is now the owner of three planes. He is a frequent visitor at Antioch College, for it is there, under the auspices of the Kettering Foundation, that 30 scientists are trying to find out "why grass is green." No doubt his plane often lands at La Grange, Ill., where his son Gene is chief engineer of the Electro-Motive Division, which produces rail diesel engines. It is the diesel's inventor, as well as the father and grandfather, who makes these visits.

T. A. Boyd, a former research associate of Kettering's, makes generous use of quoted excerpts from the latter's writings and speeches in this book. For Kettering, like Franklin, is very apt in phrasing semiphilosophical asides in his conversation and speeches. The author is frankly laudatory and gives scant space to mention of any personal quirks. However, the book's chronicle does effectively bring to the reader a sense of actual encounter with "Boss Ket" in person. And, withal, it does this through an interesting, absorbing narrative.

B. CLIFFORD HENDRICKS

Longview, Washington

New Books

A Revision of the Australian Chafers (Coleoptera: Scarabaeidae: Melolonthinae), vol. 1, E. B. Britton. British Museum (Natural History), London, 1957. 193 pp. £4.

Experimental Designs. William G. Cochran and Gertrude M. Cox. Wiley, New York; Chapman & Hall, London, ed. 2, 1957. 630 pp. $10.25.

Physiology of Prematurity. Transactions of the first conference, 21–23 Mar. 1956, Princeton, N.J. Jonathan T. Lanman, Ed. 151 pp. $3.25. *Neuropharmacology.* Transactions of the third conference, 21–23 May 1956, Princeton, N.J. Harold A. Abramson, Ed. 381 pp. $4.50. Josiah Macy, Jr., Foundation, New York, 1957.

The Molecular Theory of Solutions. I. Prigogine. North-Holland, Amsterdam; Interscience, New York, 1957. 468 pp. $13.25.

The Physiology of Induced Hypothermia. Proceedings of a symposium 28–29 Oct. 1955. Publ. 451. Robert D. Dripps, Ed. National Academy of Sciences–National Research Council, Washington, D.C., 1956. 460 pp. $3.50.

Plymouth Marine Fauna. Notes on the local distribution of species occurring in the neighborhood of Plymouth, including some other records of species found on the south coasts of Devon and Cornwall and the adjacent offshore waters of the English Channel. Marine Biological Association of the United Kingdom, ed. 3, 1957 (order from the director of the laboratory, Citadel Hill, Plymouth, Devon). 500 pp.

Prevention of Chronic Illness. vol. 1 of *Chronic Illness in the United States.* Commission on Chronic Illness. Published for the Commonwealth Fund, Harvard University Press, Cambridge, Mass., 1957. 360 pp. $6.

Pure Food and Drugs in California. August F. Glaive. National Press, Palo Alto, Calif., 1957. 214 pp. $4.50.

The Quicksilver Doctor. The life and times of Thomas Dover, physician and adventurer. Kenneth Dewhurst. Wright, Bristol, England, 1957. 201 pp. 21s.

Science Looks at Smoking. A new inquiry into the effects of smoking on your health. Eric Northrup. Coward-McCann, New York, 1957. 190 pp. $3.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

South African Pollen Grains and Spores. pt. II. E. M. Van Zinderen Bakker. Balkema, Amsterdam, Netherlands, and Cape Town, S.A. 1956. 71 pp. 15s.

Considerations about Cesalpinus' and Harvey's Works on the Blood Circulation Discovery. Alcmaeon Publications, 217 E. 116 St., New York 29, 1957. 27 pp.

Blood Tests in Mental Illness. Papers and discussions presented at the Annual Scientific Conference of the Brain Research Foundation, Chicago, Ill., 12 January 1957. Brain Research Foundation, Chicago, 1957. 47 pp.

Meterological Programme, Lists of Stations, International Geophysical Year 1957–1958. World Meteorological Organization, Geneva, Switzerland, 1957. 108 pp. F. 8.

The Population Council, Inc., Reports of the Executive Officers for the Year Ended December 31, 1956. The Council, 230 Park Ave., New York, 1957. 20 pp.

Hormones Controlling the Chromatophores of the Dwarf Crawfish, Cambarellus Shufeldti: Their Secretion, Stability, and Separation by Filter Paper Electrophoresis. Studies in Zoology, vol. 5, No. 7. Milton Fingerman and Mildred E. Lowe. Tulane University, New Orleans, La., 1957. 21 pp. $0.40.

Meetings and Societies

Antibiotics

On 31 May–7 June there was held in Moscow, U.S.S.R., the second All-Union Conference on Antibiotics. The meetings took place at the University of Moscow. The Minister of Public Health of the U.S.S.R., M. D. Kovrigina, delivered an address of welcome at the opening session. This was followed by general addresses by Z. B. Ermoleva on "New antibiotics, new therapeutic forms of antibiotics, and their experimental clinical significance," and by G. P. Rudnev on "Fundamental principles of the clinical applications of modern antibiotics in the treatment of infectious diseases." The concluding address at the conference was delivered by A. P. Grishakova—"Prospectives in the manufacture of antibiotics." There were several hundred participants.

A total of 252 papers was listed. These were divided into three sections: (i) "Search for new antibiotics," 43 papers; (ii) "Biology of antibiotic-producing organisms, chemistry and technology of antibiotics," 59 papers; (iii) "Experimental and clinical study of antibiotics," 150 papers. Although most of the papers came from the five leading institutions concerned with the study of antibiotics and antibiotic-producing organisms (Institute of Microbiology of the Academy of Sciences of the U.S.S.R., All-Union Institute of Antibiotics in Moscow, Institute for the Study of New Antibiotics in Moscow, Leningrad Institute of Antibiotics, Sverdlovsk Institute of Antibiotics), about 30 other institutions, comprising medical schools and institutes, chemical and botanical laboratories, and numerous others, were represented.

About a dozen new antibiotics were announced or discussed, in addition to many others already isolated and produced elsewhere. Practically all the new antibiotics were isolated from cultures of actinomycetes. These were designated as grisamin, actinoxantin, cerulomycin, heliomycin, celomin, crystalomycin, actinoidin, aurantin, secacin, sapropelmycin, and sapromycin. They are active upon bacteria, or fungi, or viruses, or neoplasms. Several forms of penicillin (benzyl, phenoxymethyl), one fungal product (poin), and one bacterial product (neocide) were also listed. Some of the isolated preparations are definitely known to be forms of well-known antibiotics. This is true, for example, of colimycin and miserin (forms of neomycin) and for levomycetin and synthomycin (apparently forms of chloramphenicol); biomycin is chlortetracycline.

Considerable progress on the practical production and utilization of antibiotics was reported.

National Council of Teachers of Mathematics

The National Council of Teachers of Mathematics was organized in Cleveland, Ohio, on 24 Feb. 1920 and was incorporated under the laws of Illinois on 28 Apr. 1928. From a small group of founders, the membership has grown to approximately 11,000, with 4000 additional subscribers, in the intervening 37 years.

The council has recently been accepted as an affiliate of the American Association for the Advancement of Science. The officers of the council feel this to be an honor and a privilege. This new relationship should do much to further the interests of mathematics as we work together with our fellow-scientists.

In 1950 the council became a department of the National Education Association and moved the central office to the NEA Building in Washington, D.C. This was a transition period which made a revision in the bylaws necessary. The new office now operates with an executive secretary in charge.

The administrative affairs and the program of the council are invested in a board, which functions under the provisions of the bylaws. The board is composed of the president, the immediate past president, four vice presidents (one, each, representing the elementary, junior high school, senior high school, and college levels), and nine directors. The past president does not have a vote. The directors are representatives of their special areas; hence, a good geographic distribution of the board is maintained. The board meets twice each year. Between meetings, a three-man executive committee of the board meets when necessary.

The purpose of the council is to promote interest in mathematics and to further the field of mathematics education at all levels, from the elementary school through the college and university. This is done in the following ways.

Four meetings for the presentation and discussion of papers are held each year. The annual meeting is in the spring. The attendance at this meeting is always more than 1000. Other meetings are held in late summer, at the Christmas season, and in conjunction with the annual meeting of the NEA.

The council publishes three journals: (i) The *Mathematics Teacher,* published eight times per year, is devoted to the interests of mathematics teachers in high schools and colleges. This is the official organ of the council. (ii) The *Arithmetic Teacher,* published six times per year, is devoted to the interests of mathematics teachers in elementary schools. (iii) The *Mathematics Student Journal,* published for the purpose of developing an interest in mathematics on the part of the high-school student, appears four times each year.

The council publishes a yearbook but not necessarily annually. Twenty-two yearbooks have been published, and the 23rd will appear this year. The yearbooks are major publications which deal with subjects of general interest and importance in the field of mathematics. An increasing number of pamphlet-size publications on specific subjects are being published annually.

The council has a plan whereby regional, state, county, and city mathematical organizations may affiliate. This program has done much to increase interest in the work of the council. At each annual meeting there is a meeting of the delegates of the affiliated groups. Each group is permitted one voting delegate. At present there are 64 mathematical groups affiliated with the council.

There are nearly 30 standing and special committees. These delve into all phases of mathematics education. Some are research committees, others are promotional. The important work of the council has its source in these committees. They report to the board twice each year.

The council is the only mathematical organization which brings teachers of all levels together. It is recognized today, as never before, that all teachers of mathematics must work together to solve our instruction and curriculum problems and provide the necessary supply of people trained in mathematics. It is indeed unusual and inspiring to see these teachers working together and enjoying mutual fellowship at one of the council meetings.

HOUSTON T. KARNES
Louisiana State University, Baton Rouge

Radioisotopes Conference

An International Conference on Radioisotopes in Scientific Research will be held in Paris, 9–20 Sept. This conference is being convened by UNESCO, after consultation with the United Nations Secretariat and interested specialized agencies, in particular the World Health Organization, the United Nations Food and Agriculture Organization, and the World Meteorological Organization. The purpose of the conference is to bring together a large number of specialists in the various scientific disciplines interested in the use of radioistopes, so that they may submit the results of their research and exchange information and views on a series of subjects in which developments are proceeding at a rapid pace.

Plans for the conference were made by C. D. Coryell (United States), Ch. Fisher (France), F. M. Gomes (Brazil), T. Hamada (Japan), C. Jech (Czechoslovakia), A. S. Rao (India), I. D. Rojansky (U.S.S.R.), H. Seligman (United Kingdom), V. S. Vavilov (U.S.S.R.), and representatives of the following organizations: United Nations Food and Agriculture Organization (R. A. Silow), World Health Organization (I. S. Eve), World Meteorological Organization (P. J. Meade), and European Organization for Nuclear Research (A. Lundby).

Photographic Scientists

The Society of Photographic Scientists and Engineers will hold its annual meeting at the Berkeley-Carteret Hotel in Asbury Park, N.J., 9–13 Sept. The conference will be conducted with the cooperation of the U.S. Army's Signal Engineering Laboratories. Papers will cover experimental and theoretical studies as well as practical design of instruments, apparatus, and systems.

Charles E. Ives (Kodak Research Laboratories) is program chairman, and cochairmen are Carl Orlando (Fort Monmouth, N.J.) and Arthur E. Neumer (Eastman Kodak Company).

Instrument-Automation Conference

The 12th annual Instrument-Automation Conference and Exhibit of the Instrument Society of America will be held in Cleveland, Ohio, 9–13 Sept. The theme of the conference is "Instrumentation for systems control," and speakers will include Simon Ramo, executive vice president, Ramo-Wooldridge, Los Angeles, and Cuthbert Hurd, director of central research for IBM.

A new conference feature, the Systems Workshop, keyed to probing into the relatively new "systems" concept will be led by Chalmer E. Jones of Daystrom, Inc. Discussions will cover such topics as aircraft and missiles (excluding propulsion); wind tunnel; flight propulsion systems; process industries; power generation and distribution; meteorological, nuclear, medical, geophysical exploration, and general industrial laboratories; oscillographic and photographic data reduction; data transmission and storage; analog-to-digital and digital-to-analog converters; real time digital computer applications; real time analog computer applications; transducers; data for human consumption; data for management decisions and validity checks; error detection and editing.

Another feature of the conference will be the Computers Application Clinic, at which the discussion is expected to point to the many and varied applications of computers to problems of design, analysis, and simulation.

Members of the AAAS may attend the Cleveland conference and exhibit without paying the $1 registration fee by requesting an advance invitation form from the exhibit manager, Fred J. Tabery, 3443 S. Hill St., Los Angeles 7, Calif.

International Microbiology

Word has just reached the Society of American Bacteriologists that *15 Sept. 1957* is the deadline for receipt of preliminary applications for participation in the seventh International Congress for Microbiology to be held in Stockholm, Sweden, 4–9 Aug. 1958. Persons wishing to attend the congress should immediately request the necessary forms and instructions from F. C. Harwood, Business Manager, SAB, Waverly Press, Inc., Mt. Royal and Guilford Aves., Baltimore 2, Md. Those who do not intend to give a paper should write the words "auditor only" on the application.

Cryogenic Engineering

More than 40 papers on a variety of topics associated with the production and use of liquefied gases such as hydrogen, nitrogen, oxygen, and helium will be given at the 1957 Cryogenic Engineering Conference, 19–21 Aug., at the Boulder Colorado Laboratories of the National Bureau of Standards.

Since World War II, more and more research has been done with liquids colder than 400° below zero in order to learn more about the unusual problems associated with practical use of them, and industry is becoming vitally concerned with cryogenics problems because of the virtually untapped potential offered by the use of very cold liquids in such areas as commercial atomic energy and space flight.

The Cryogenic Conference was initially planned to be held every 2 years. The first was in 1954 and the second in 1956. Pace in developments has been so great, however, that yearly conferences have been requested by industry and defense.

Committee members for this year's conference are S. C. Collins, Massachusetts Institute of Technology; E. F. Hammel, Los Alamos Scientific Laboratory; W. T. Ziegler, Georgia Institute of Technology; and B. W. Birmingham, R. B. Scott, and K. D. Timmerhaus, National Bureau of Standards.

Society Elections

■ Phi Lambda Upsilon: pres., Carl S. Carlson, Standard Oil Company (N.J.); v. pres., Thomas B. Cameron, University of Cincinnati; sec., Milton Tamres, University of Michigan; treas., William G. Schrenk, Kansas State College, Manhattan.

■ American Society of Agricultural Engineers: pres., E. D. Anderson, Stran-Steel Corp., Detroit, Mich.; sec., J. L. Butt, St. Joseph, Mich.; treas. and asst. sec., R. A. Palmer, St. Joseph, Mich. The vice presidents are W. J. Ridout, Jr., New York; L. W. Hurlbut, University of Nebraska; H. J. Barre, Mansfield, Ohio. Representative to the AAAS Council is Eugene G. McKibben, USDA.

■ Lancaster Branch, AAAS: chair., Robert L. Moore; vice chair., Thomas Mariner; treas., Michael A. Lewis; sec., Wilhelmina S. Scott.

Forthcoming Events

September

16–21. Orthopedic Surgery and Traumatology, 7th internatl. cong., Barcelona, Spain. (J. M. Vilardell, Avenida Jose Antonia 654, Barcelona.)

17–20. International Union of Pure and Applied Physics 9th general assembly, Rome, Italy. (P. Fleury, IUPAP, 3, boulevard Pasteur, Paris 15e, France.)

17–24. Industrial Chemistry, 30th internatl. cong., Athens, Greece. (Committee of Organization, 30th internatl. Cong. of Industrial Chemistry, Rue Kaningos 10, Athens.)

18–20. Formation and Stabilization of Free Radicals, symp., Washington, D.C. (A. M. Bass, Free Radicals Research Section, National Bureau of Standards, Washington 25.)

18–21. Child Psychology Symp., Worcester, Mass. (D. Evans, News Bureau, Clark Univ., Worcester.)

18–21. International Mineral Dressing Cong., Stockholm, Sweden. (J. Hedlund, IMDC, Näckströmsgatan 1III, Stockholm C.)

18–28. Ethnological Conf., 4th internatl., Freiburg, Breisgau, Germany. (D. O. Koehler, Zoologisches Institut, Albert Ludwig Universität, Freiburg.)

19–21. Office Dermatology, postgraduate conf., San Francisco, Calif. (Office of the Dean, Stanford Univ. School of Medicine, 2398 Sacramento St., San Francisco 15.)

22–28. Mesons and Recently Discovered Particles, colloquium, IUPAP, Venice, Italy. (A. Rostagni, Istituto di Fisica dell' Universita, Via Marzolo 8, Padua, Italy.)

23–24. Fluid Flow in Porous Media, Conf., Norman, Okla. (C. G. Dodd, Petroleum Engineering Dept., Univ. of Oklahoma, Norman.)

23–25. American Soc. of Mechanical Engineers, fall, Hartford, Conn. (C. E. Davies, ASME, 29 W 39 St., New York 18.)

23–27. International Soc. of Bioclimatology and Biometeorology, Vienna, Austria. (S. W. Tromp, Hofbrouckerlaan 54, Oegstgeest-Leiden, Holland.)

24–25. Industrial Electronics Conf., Chicago, Ill. (E. A. Roberts, Union Thermoelectric Corp., 2001 Greenleaf St., Evanston, Ill.)

25–27. Mississippi Valley Medical Soc., annual, St. Louis, Mo. (H. Swanberg, 510 Maine St., Quincy, Ill.)

28–30. American College of Hospital Administrators, 23rd annual, Atlantic City, N.J. (D. Conley, ACHA, 620 N. Michigan Ave., Chicago 11, Ill.)

29–5. World Medical Assoc., Istanbul, Turkey. (L. H. Bauer, 10 Columbus Circle, New York 19.)

30–2. American Oil Chemists' Soc., fall, Cincinnati, Ohio. (Miss L. R. Hawkins, AOCS, 35 E. Wacker Dr., Chicago 1, Ill.)

30–8. International Council for the Exploration of the Sea, 45th annual, Bergen, Norway. (A. Fridriksson, ICES, Charlottenlund Slot, Charlottenlund, Denmark.)

October

1–4. American Roentgen Ray Soc., annual, Washington, D.C. (B. R. Young, Germantown Hospital, Philadelphia 44, Pa.)

2–4. American Soc. of Photogrammetry, semi-annual, St. Louis, Mo. (C. E. Palmer, ASP, 1515 Massachusetts Ave., NW, Washington 5.)

2–4. Antibiotics, 5th annual symp., Washington, D.C. (H. Welch, Div. of Antibiotics, Food and Drug Administration, U.S. Dept. of Health, Education, and Welfare, Washington 25.)

4. Role of Agriculture in Future Society, 75th anniversary symp., Geneva, N.Y. (New York State Agricultural Experiment Station, Cornell Univ., Geneva.)

4–6. Indiana Geologic Field Conf., 9th, Mitchell, Ind. (H. H. Gray, Indiana Field Conf., Dept. of Conservation, Geological Survey, Bloomington, Ind.)

6–10. Electrochemical Soc., fall, Buffalo, N.Y. (H. B. Linford, 1860 Broadway, New York 23.)

7–9. National Electronics Conf., Chicago, Ill. (J. S. Powers, NEC, 84 E. Randolph St., Chicago 1.)

7–11. American Inst. of Electrical Engineers, fall general, Chicago, Ill. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

7–11. Research Contributions to Clinical Practice, New York Acad. of Medicine Postgraduate Week, New York. (Secretary, Postgraduate Week, New York Acad. of Medicine, 2 E. 103 St., New York 29.)

8–10. International Assoc. of Milk and Food Sanitarians, annual, Louisville, Ky. (H. H. Wilkowske, Dairy Science Dept., Univ. of Florida, Gainesville.)

8–10. Upper Air Conf., American Meteorological Soc., Omaha, Nebr. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

9–11. High Vacuum Technology, 4th annual symp., Boston, Mass. (Committee on Vacuum Techniques, P.O. Box 1282, Boston 9.)

9–11. Society for Experimental Stress Analysis, fall, San Diego, Calif. (W. M. Murray, SESA, P.O. Box 168, Cambridge 39, Mass.)

9–12. Tau Beta Pi Assoc., annual, Madison and Milwaukee, Wis. (R. H. Nagel, Univ. of Tennessee, Knoxville.)

10–11. Noise Abatement Symp., 8th annual, Chicago, Ill. (J. J. Kowal, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

10–13. Angiology, 3rd internatl. cong., Atlantic City, N.J. (H. Haimovici, 105 E. 90 St., New York 28.)

13–18. American Acad. of Ophthalmology and Otolaryngology, annual, Chicago, Ill. (W. L. Benedict, 100 First Avenue Bldg., Rochester, Minn.)

14–16. Association of Official Agricul-

SOVIET BIOLOGY RESEARCH IN COMPLETE ENGLISH TRANSLATION

IMPORTANT NEW COLLECTIONS AND CURRENT JOURNALS

BULLETIN OF EXPERIMENTAL BIOLOGY AND MEDICINE—Translation began with 1956 volume. Twelve issues per year, annual subscription **$20.00**

BIOCHEMISTRY—Translation began with 1956 volume. Six issues per year, annual subscription **$20.00**

PHARMACOLOGY AND TOXICOLOGY—*Farmakologiya i Toksikologiya*, one of the most important Soviet biological periodicals. More than 600 pp. per year, published in six issues. Translation began with the 1957 volume. By special arrangement with the American pharmaceutical industry, the annual subscription is only **$25.00**

DOKLADY: BIOCHEMISTRY SECTION—The biochemical section of the Proceedings of the Academy of Sciences, USSR. Papers by leading Soviet biochemists, representing the most advanced Russian work in this field. Translation began with the 1957 volume. Originally published in 36 issues, published by Consultants Bureau in 6. Annual subscription **$65.00**

RADIOBIOLOGY COLLECTION—Seven papers on X-ray irradiation of mice: Damage to hematopoietic organs; sterilizing action of ionizing radiation; etc. Originally published by the Institute of Genetics and the Institute of Biophysics of the Academy of Sciences, USSR. Complete English translation, 134 pages **$50.00**

REMOTE CONSEQUENCES OF RADIATION—Summaries of papers presented at the Conference on the Remote Consequences of Injuries Caused by the Action of Ionizing Radiation. Twenty-two papers on changes in the peripheral blood, formation of neoplasms, etc., in dogs, rats, and mice exposed to radiation. Complete English translation, 74 pages **$10.00**

soon to be published

PHARMACEUTICAL CHEMISTRY—Important pharmaceutical papers selected from 5 Soviet chemical journals (1949–1955). Presents in an organized fashion over 225 pharmaceutical research papers, previously scattered throughout the translated Russian chemical literature. Table of Contents upon request. Price to be announced.

All Consultants Bureau translations are by scientists who are specialists in each field, equally familiar with Russian and the technical vocabulary. All material is translated cover-to-cover, staple bound, and includes all diagrams, photographs, and tabular matter integral with the text. Issues are mailed to subscribers upon publication. Single articles are available—write for free Tables of Contents, specifying journal desired.

SEE OUR PUBLICATIONS AT THE AIBS LIBRARY EXHIBIT, STANFORD, CALIFORNIA MEETING, AUGUST 25 thru 29.

Consultants Bureau is still seeking Scientist-Translators.

CONSULTANTS BUREAU, INC.

227 WEST 17th STREET, NEW YORK 11, N. Y. — U.S.A.

Telephone: ALgonquin 5-0713 • Cable Address: CONBUREAU, NEW YORK

The new, safe way to pack, ship and handle

HYDROGEN PEROXIDE H_2O_2 (30%)

FISHER

SPUN ALUMINUM CONTAINERS

- UNBREAKABLE CANISTER
- SAFETY SCREW CAP
- ANALYSIS ON LABEL

AT NO INCREASES IN PRICES

Unbreakable, protected against pressure blowouts, ICC-approved without costly packing—that's the new and exclusive aluminum container Fisher uses for its H_2O_2 (30%) in Certified, Reagent, and Technical grades.

Aluminum packaging assures safer and easier handling of the Hydrogen Peroxide and more stability for a longer period. B-45a

A "gold mine" of chemicals yours for the asking

Write for Chemical Index 120C.

FISHER SCIENTIFIC

IN THE U.S.A. Boston, Buffalo, Charleston, W.Va., Chicago, Cleveland, Detroit, New York, Philadelphia, Pittsburgh, St. Louis, Washington IN CANADA Edmonton, Montreal, Toronto

America's Largest Manufacturer-Distributor of Laboratory Appliances & Reagent Chemicals

139 Fisher Building, Pittsburgh 19, Pa.

tural Chemists, 71st annual, Washington, D.C. (W. Horwitz, Box 540, Benjamin Franklin Station, Washington 4.)

14–18. American College of Surgeons, 43rd annual clinical cong., Atlantic City, N.J. (ACS, 40 E. Erie St., Chicago 11, Ill.)

14–18. American Soc. of Civil Engineers, New York, N.Y. (W. H. Wisely, ASCE, 33 W. 39 St., New York 18.)

14–18. International Industrial Development Conf., San Francisco, Calif. (E. S. Prentice, Stanford Research Inst., Menlo Park, Calif.)

16–23. Enzyme Chemistry, internatl. symp., Tokyo and Kyoto, Japan. (International Symp. on Enzyme Chemistry, Science Council of Japan, Ueno Park, Tokyo.)

17–18. American Ceramic Soc., 10th Pacific Coast mtg., San Francisco, Calif. (C. E. Pearce, ACS, 4055 N. High St., Columbus 14, Ohio.)

17–18. Industrial Hydraulics, natl. conf., Chicago, Ill. (Conference Secretary, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

17–19. Indiana Acad. of Science, Greencastle. (H. Crull, Dept. of Mathematics, Butler Univ., Indianapolis 7, Ind.)

17–19. Optical Soc. of America, Columbus, Ohio. (S. S. Ballard, Visibility Lab., Scripps Institution of Oceanography, San Diego 52, Calif.)

18–19. National Soc. of Professional Engineers, Bismark, N.D. (P. H. Robbins, 2029 K St., NW, Washington 6.)

19–26. Social Work, 3rd Pan American cong., San Juan, Puerto Rico. (A. Porrata Dorla, Apartado 3271, San Juan.)

20–22. American College of Apothecaries, St. Louis, Mo. (R. E. Abrams, Hamilton Court, Chestnut and 39 St., Philadelphia, Pa.)

21. Air Pollution Symp., 2nd annual, Philadelphia, Pa. (A. D. Hollingsworth, Franklin Inst., Benjamin Franklin Parkway at 20th, Philadelphia 3.)

21–25. Medical Aspects of Workmen's Compensation, New York. (Office of Associate Dean, New York Univ. Post-Graduate Medical School, 550 First Ave., New York 16.)

21–26. Ultra High Frequency Circuits and Antennas, internatl. conf., Paris, France. (Congrès Circuits et Antennes Hyperfréquences, Société des Radioélectriciens, 10, Avenue Pierre-Larousse, Malakoff (Seine), France.)

22. American Soc. of Safety Engineers, annual, Chicago, Ill. (J. B. Johnson, ASSE, 425 N. Michigan Ave., Chicago 11.)

22–25. American Dietetic Assoc., annual, Miami, Fla. (Miss R. M. Yakel, ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

24–25. Computer Applications Symp., Chicago, Ill. (Conference Secretary, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

24–25. New Mexico Acad. of Science, annual, Albuquerque. (W. J. Koster, Dept. of Biology, Univ. of New Mexico, Albuquerque.)

24–26. Acoustical Soc. of America, Ann Arbor, Mich. (W. Waterfall, ASA, 57 E. 55 St., New York 22.)

24–5. Pan Indian Ocean Science Assoc., 3rd cong., Tananarive, Madagascar. (R. Paulian, Institut de Recherche Scientifique, B.P. 434, Tananarive.)

25–26. Kentucky Acad. of Science, Berea. (G. Levey, Berea College, Berea.)

25–28. American Heart Assoc. Scientific Sessions, Chicago, Ill. (Medical Director, AHA, 44 E. 23 St., New York 10.)

26. American Mathematical Soc., Washington, D.C. (J. H. Curtiss, AMS, 190 Hope St., Providence 6, R.I.)

27–1. Atom Fair, New York, N.Y. (Atomic Industrial Forum, 3. E. 54 St., New York 22.)

28–30. Association of Military Surgeons of the U.S., annual, Washington, D.C. (R. E. Bitner, AMSUS, Suite 718, 1726 Eye St., Washington 6.)

28–31. American Nuclear Soc., 2nd winter, New York, N.Y. (J. Burt, J. M. Mathes, Inc., 260 Madison Ave., New York 16.)

29–31. Entomological Soc. of Canada, annual, Lethbridge, Alta., Canada. (R. H. Wigmore, Science Service Bldg., Carling Ave., Ottawa 3, Ont.)

29–3. Photoperiodism in Plants and Animals, internatl. conf., Gatlinburg, Tenn. (R. Winthrow, Division of Radiation and Organisms, Smithsonian Inst., Washington 25, D.C.)

30–2. American Soc. of Parasitologists, annual, Philadelphia, Pa. (P. E. Thompson, Research Div., Parke, Davis & Co., Detroit 32, Mich.)

30–2. American Soc. of Tropical Medicine and Hygiene, annual, Philadelphia, Pa. (R. B. Hill, 3575 St. Gaudens Rd., Miami 33, Fla.)

30–2. Federation of Paint and Varnish Production Clubs, 35th annual, Philadelphia, Pa. (FPVPC, 121 S. Broad St., Philadelphia 7.)

31. Reactor Safety Conf., New York, N.Y. (Atomic Industrial Forum, 3 E. 54 St., New York 22.)

31–2. Engineering and Scientific Education Conf., Chicago, Ill. (J. E. Harrington, Western Soc. of Engineers, 84 E. Randolph St., Chicago 1.)

31–2. Gerontological Soc., annual, Cleveland, Ohio. (N. W. Shock, Baltimore City Hospitals, Baltimore 24, Md.)

November

2–8. World Metallurgical Cong., 2nd, Chicago, Ill. (W. H. Eisenman, American Soc. for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.)

2–10. Measuring Instruments and Automation, internatl. cong., Düsseldorf, Germany. (Nordwest Deutsche Ausstellungs Gesellschaft, M.B.H., Ehrenhof 4, Düsseldorf.)

3. American College of Dentists, annual, Miami, Fla. (O. W. Brandhorst, 4221 Lindell Blvd., St. Louis 8, Mo.)

3. Society of Vertebrate Paleontology, annual, Philadelphia, Pa. (J. T. Gregory, Peabody Museum, Yale Univ., New Haven, Conn.)

3–9. Pan American Cong. of Pharmacy and Biochemistry, 4th, Washington, D.C. (G. Griffenhagen, Smithsonian Institution, Washington 25.)

4–5. Society of Vertebrate Paleontology, technical sessions, Atlantic City, N.J. (J. T. Gregory, Peabody Museum, Yale Univ., New Haven, Conn.)

4–6. Geological Soc. of America, an-

nual, Atlantic City, N.J. (H. R. Aldrich, GSA, 419 W. 117 St., New York 27.)

4–6. Mineralogical Soc. of America, annual, Atlantic City, N.J. (C. S. Hurlbut, Jr., Dept. of Mineralogy, Harvard Univ., Cambridge 38, Mass.)

4–6. Paleontological Soc., annual, Atlantic City, N.J. (H. B. Whittington, Museum of Comparative Zoology, Harvard Univ., Cambridge 38, Mass.)

4–6. Society of Economic Geologists, annual, Atlantic City, N.J. (H. M. Bannerman, U.S. Geological Survey, Washington 25.)

4–7. American Dental Assoc., annual, Miami, Fla. (H. Hillenbrand, 222 E. Superior St., Chicago 11, Ill.)

6–8. Electronic Techniques in Medicine and Biology, Boston, Mass. (H. S. Kindler, Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

7–9. Animal Care Panel, 8th annual, San Francisco, Calif. (R. J. Flynn, ACP, Box 299, Lemont, Ill.)

7–9. Society of Rheology, annual, Princeton, N.J. (W. R. Willets, Titanium Pigment Corp., 99 Hudson St., New York 13.)

10–13. Society of American Foresters, 57th annual, Syracuse, N.Y. (H. Clepper, SAF, 415 Mills Bldg., Washington 6.)

10–13. Xi Sigma Pi, Syracuse, N.Y. (J. R. Parker, School of Forestry, Univ. of Georgia, Athens.)

10–14. Society of Exploration Geophysicists, 27th annual, Dallas, Tex. (J. C. Hollister, Colorado School of Mines, Golden.)

11–13. Radio Fall Meeting, IRE, Toronto, Ont., Canada. (V. Graham, RETMA, 11 W. 42 St., New York 26.)

11–14. American Petroleum Inst., 37th annual, Chicago, Ill. (API, 50 W. 50 St., New York 20.)

11–15. American Public Health Assoc., 85th annual, Cleveland, Ohio. (R. M. Atwater, APHA, 1790 Broadway, New York 19.)

11–15. American Soc. of Professional Biologists, annual, with American Public Health Assoc., Cleveland, Ohio. (A. F. Borg, Dept. of Bacteriology, Kansas State College, Manhattan.)

13–15. American Meteorological Soc., College Station, Tex. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

13–15. Clinical Chemistry Symp., Cleveland, Ohio. (F. E. Bunts Educational Inst., Cleveland, Clinic Foundation, 2020 E. 93 St., Cleveland 6.)

13–15. Standards, 8th national conf., San Francisco, Calif. (American Standards Assoc., 70 E. 45 St., New York 17.)

13–16. Society of Naval Architects and Marine Engineers, 65th annual, New York. (W. N. Landers, SNAME, 74 Trinity Pl., New York 6.)

14–15. Operations Research Soc. of America, Pittsburgh, Pa. (M. L. Ernst, Box 2176, Potomac Station, Alexandria, Va.)

14–16. American Soc. of Refrigerating Engineers, Chicago, Ill. (R. C. Cross, ASRE, 234 Fifth Ave., New York 1.)

17–22. Radiological Soc. of North America, annual, Chicago, Ill. (D. S. Childs, 713 E. Genesee St., Syracuse, N.Y.)

LOURDES

Large Volume!... Super-Speed...

refrigerated centrifuge

Model LR

The Model LR features a new design refrigeration system which employs forced air circulation through side and bottom cooling areas to provide a continuous laminar flow of cool air streams onto all portions of the rotor. Chamber temperatures may be set as low as —15° C and, automatically maintained within ±1° C. Rotor compartment temperatures are easily maintained at 0° C and lower, even during runs at maximum speed for extended periods.

Instrumentation includes a continuous reading electric tachometer, two hour timer, automatic temperature controller, variable speed controller, ammeter for rotor acceleration control and various operating safety controls.

A full 1 Hp. Universal motor provides direct power to any rotor employed, without the use of cumbersome high speed attachments, pulleys or gears. All rotors are interchangeably used in both refrigerated and non-refrigerated Lourdes' centrifuges without the use of special adapters.

More compact and competitively priced, the Model LR offers highest quality construction, maximum operating efficiency and unsurpassed performance.

FOUR INTERCHANGEABLE ROTORS

ROTOR	CAPACITY (Max.)	RPM (Max.)	RCF x G (Max.)
11° Angle	1,500cc (6x250cc)	11,000	20,000
9° Angle	400cc (8x50cc)	15,300	30,000
9° Angle	360cc (24x15cc)	15,300	30,000
Swinging Cup	96cc (8x12cc)	12,000	21,500

NOTE: Adapters available for smaller tubes

Backed by over a decade of laboratory instrument manufacturing experience, each LOURDES' *unit is guaranteed for a period of one year.*

LOURDES INSTRUMENT CORP.

53rd STREET and 1st AVENUE • BROOKLYN 32, N. Y.

WRITE FOR LITERATURE. REFER TO S-87

LARGEST MANUFACTURER OF SUPER-SPEED CENTRIFUGES

ADVANCES IN EXPERIMENTAL CARIES RESEARCH

AAAS SYMPOSIUM VOLUME

June 1955

246 pp., 6" x 9", 49 illus., index, clothbound

Price $6.75; cash order price for AAAS members **$5.75**

". . . This is a real contribution to dental science. It is the most comprehensive review of animal experimentation on caries ever attempted. The format and reproduction of illustrations are excellent.

"This compilation of research findings should have wide circulation and should be a storehouse of information for all those who are investigating the problem of dental caries. It should serve to clarify the thinking and prevent useless duplication in future studies. . . ."

Russell W. Bunting, School of Dentistry, University of Michigan.

AAAS, 1515 Mass. Ave., NW, Washington 5, D.C.

TEMCO

Handy, highly accurate Portable Pyrometer

Choice of four triple scale ranges:

500°F. — 260°C. — 18 MV
800°F. — 430°C. — 17 MV
1600°F. — 865°C. — 36 MV
2250°F. — 1225°C. — 50 MV

Scale mirrored to eliminate parallax.
8 feet of thermocouple and lead wire.
Fahrenheit thermometer for cold-junction setting.
Sturdy carrying case . . .
7" x 9" x 4½" . . . Detachable cover.

Price, complete with case, only $49.50

Write for name of nearest dealer and for complete, illustrated TEMCO Catalog.

THERMO ELECTRIC MFG. CO.
568 Huff Street, Dubuque, Iowa

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science *does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ MILLIVOLT RECORDER has sensitivity as high as full scale for 1 mv. A high-gain, chopper-type amplifier feeds a standard 5 ma d-c measuring mechanism with less than 1 μa drain on the measured circuit. Response time for full-scale deflection is ¾ sec. Synchronous-motor chart drive or 60-day spring-motor drives are available. Four ranges, 1, 2, 5, or 10 mv, are selectable by change of a plug-in resistor. (General Electric Co., Dept. S549)

■ TRANSISTOR POWER SUPPLY furnishes d-c power variable from 0.5 to 7.0 v. A maximum current of 300 ma is furnished. Ripple is less than 1 mv at full load. Regulation is 50 mv over the input range 105 to 125 v a-c. Internal impedance is 0.5 ohm. (Kay Electric Co., Dept. S532)

■ RADIO-FREQUENCY PROBE is transistorized. Gain is unity, stabilized by a feedback amplifier. Frequency response is 1 db down at 50 cy/sec and 12 Mcy/sec, 3 db down at 20 cy/sec and 15 Mcy/sec. Input impedance is 4 μμf and 100 kohm. Output impedance is 50 ohm. (Kay Electric Co., Dept. S553)

■ FREQUENCY INDICATOR counts events during 0.1-, 1-, or 10-sec intervals. Maximum count rate is 100,000/sec. Glow transfer tubes are used for counting and for display. The indication may be recorded on standard printer tape. Input sensitivity is 50 mv. Automatic-recycle or single-reading modes of operation are available. (Electro-Pulse Inc., Dept. S534)

■ VACUUM DISTILLATION UNIT has a capacity of up to 200 lb/hr. The equipment is designed for push-button operation. A film-type preheater-degasser is a feature of the still. All instruments necessary for operation are incorporated in a control panel. (Arthur F. Smith Co., Dept. S503)

■ HELICAL RECORDER records analog data in the range from direct current to 35 cy/sec. Heat-sensitive paper is used for the record, a sheet 38 by 11⅞ in. accommodating a spiral record up to 1360 ft long. Paper speed and trace separation can be varied. Two-thirds of the record is visible at any time. (Geotechnical Corporation, Dept. S504)

■ PRESSURE TRANSDUCER converts a 3- to 15-lb/in.^{2} signal to a proportional a-c signal. Motion of a pressure capsule is sensed by a differential transformer. Accuracy is said to be ± 0.25 percent of full scale. (Fischer and Porter Co., Dept. S517)

■ DIGITAL OHMMETER permits measurement of resistance from 10 mohm to 10 Mohm with a single instrument. Accuracy ranges from ± 0.1 to 0.01 percent depending on the range of resistance being measured. Readout time is approximately 1 sec. The instrument is based on a switching unit containing three arms of a Wheatstone bridge. (Electro Instruments Inc., Dept. S521)

■ IGNITION APPARATUS is suitable for determination of ignition temperatures of plastics and other solids and for evaluation and classification of combustible materials. (Custom Scientific Instruments, Inc., Dept. S522)

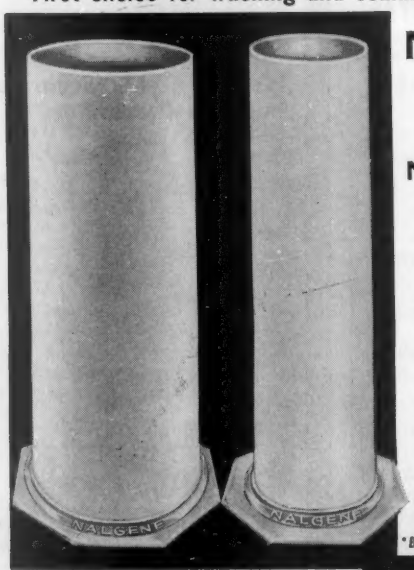
■ NEUTRON COUNTER features a subminiature preamplifier constructed into a BF_3 detector tube to allow the detector assembly to be operated 50 ft or more from the equipment into which it feeds. Fast neutron response is constant from 100 kev to 5 Mev. Sensitivity is 560 count/min per neutron, per second, per square centimeter for a Po-Be source. (Tullamore Electronics Laboratory, Dept. S524)

■ LEAK DETECTOR of the helium-mass-spectrometer type can detect a leak rate of 1×10^{-10} standard cubic centimeters of air per second. Response time may be as low as 2 sec. The instrument has been specifically designed for simplicity in use and maintenance. The mass-spectrometer tube can be removed and replaced without shutting down the vacuum system. (General Electric Co., Dept. S531)

■ HARDNESS TESTER reduces operator fatigue by motorization of the major load. Elimination of human variability in application of load is also said to contribute improved accuracy. Standard models have 8- and 12-in. vertical capacity. Special models with 4- and 16-in. capacity are available. (Torsion Balance Co., Dept. S523)

■ PRESSURE PICKUP is capable of operating continuously at 500°F. The pickup is based on the unbonded-strain-gage principle, whereby displacement of a diaphragm is sensed by strain-gage resistors arranged in a bridge circuit. Compensation for wide variations of ambient

First choice for washing and soaking pipets . . . glassware!



NALGENE* PIPET JARS *with NEW* NON-TIP BASES

The resiliency of Nalgene* Polyethylene sharply reduces breakage and the new base design practically *eliminates* tipping accidents. New non-tip base is *molded* into jar (not welded) and assures steadier, *longer life* with perfect bond.

NALGENE PIPET JARS come in standard sizes as listed below; special lengths made on order.

Ask you dealer for catalog E-956

**Brand Name for Nalge Polyethylene ware.*

SIZE	A	B	C	D	E	F
Dim. Inches Nominal	5x8	6½x9	5x18	6½x18	6½x27	6½x36
No. in Case	12	12	6	6	6	6
Each	9.50	10.50	11.50	13.50	17.50	20.50

Discount: Less 10% in case lots.

the NALGE CO. Inc.
ROCHESTER 2, NEW YORK

WORLD'S LARGEST PRODUCER OF POLYETHYLENE LABORATORY WARE!

Enthusiastically accepted by clinical laboratories all over the world—

Sigma's New Colorimetric Procedure for SERUM GO- and GP- TRANSAMINASE

operates at 480 to 530 mμ

ENTIRE PROCEDURE REQUIRES ONLY 4 SIMPLE STEPS!

1. Add 0.2 ml serum to 1 ml Prepared Substrate at 37° or 40°C.
2. After 60 minutes, add 1 ml Color Reagent (wait only 30 minutes after determining SGP-T).
3. After 20 minutes at room temperature, add 10 ml 0.4N NaOH.
4. After 30 minutes more, read vs water at approximately 505 mμ.

MINIMUM KIT (100 Determinations) Stock No. 505—$13.50
For SGP-T add substrate, Stock No. 505-51—$6.00

***DOES NOT REQUIRE** an ultraviolet spectrophotometer or deproteinization with T.C.A., or centrifuging, or extraction with Toluene as in other published methods.*

DO NOT CONFUSE THIS PROCEDURE WITH OTHER COLORIMETRIC METHODS THAT ARE OF QUESTIONABLE ACCURACY

SATISFACTION WITH THE SIGMA PROCEDURE IS ABSOLUTELY GUARANTEED.

Write for our Bulletin #505

Certainly the procedure of choice for

SERUM PHOSPHATASE

SIGMA 104 PHOSPHATASE SUBSTRATE
(p-Nitrophenyl Phosphate, Sigma Grade)

100 DETERMINATIONS, Complete Kit, #104 —$ 9.30
200 DETERMINATIONS, Complete Kit, #104A—$13.00

Complete trial kit #104S available gratis (40 acid or alkaline determinations)

Ask for Bulletin #104

NEW! TECHNICAL BULLETIN #500
The Original Berger-Broida
COLORIMETRIC PROCEDURE FOR SERUM LACTIC DEHYDROGENASE
at approximately 500 mμ.

Catalog available on request offering the world's most complete list of high purity nucleotides

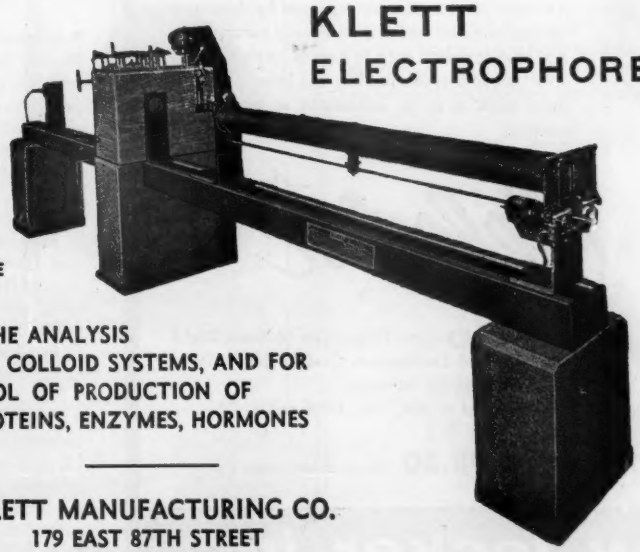
PHONE COLLECT: DAN BROIDA

Call Sigma for reagents for any Transaminase Procedure

SIGMA
CHEMICAL COMPANY
3500 DeKalb STREET, ST. LOUIS 18, MO., U.S.A
MANUFACTURERS OF THE FINEST BIOCHEMICALS AVAILABLE

St. Louis, Missouri
***Office:* PR 1-5750**
***Home:* WY 3-6418**

KLETT
ELECTROPHORESIS



CUSTOM MADE

TOOL FOR THE ANALYSIS OF COMPLEX COLLOID SYSTEMS, AND FOR THE CONTROL OF PRODUCTION OF PURIFIED PROTEINS, ENZYMES, HORMONES

KLETT MANUFACTURING CO.
179 EAST 87TH STREET
NEW YORK, N. Y.

temperature is provided by locating the two inactive arms of the bridge in close proximity to the active windings. (Consolidated Electrodynamics Corp., Dept. S551)

■ POWER SUPPLY, fully transistorized, supplies 100 to 150 v at 0 to 1.5 amp, regulated to better than ± 0.1 percent against either line or load changes. Ripple is less than 1.0 mv. The supply dissipates less than 50 w to deliver 225 w. (NJE Corp., Dept. S505)

■ ELECTRONIC FIBER-FINENESS INDICATOR scans a sample of fibers on a slide, measuring fiber diameter and computing an average. The image cast by each fiber as it passes through a light beam is presented to a multiplier phototube which produces an electric signal starting at the time the leading edge is seen and persisting until the trailing edge passes. The duration of the signal is a measure of diameter. The signal durations are counted for 1000 fibers, providing an average diameter. (National Research Corporation, Dept. S552)

■ THERMAL WIRE STRIPPER is designed for use with Teflon insulated wire. Interchangeable electrodes are available to handle wire from A.W.G. Nos. 14 to 32. Operation is on 15-v alternating current. (Contact, Inc., Dept. S555)

■ SILICON MONOMER, pentamethyldisiloxanemethylmethacrylate, can be copolymerized with acrylonitrile, styrene, vinyl acetate, and methyl methacrylate to yield plastics with unusual properties. A 30-percent copolymer with methylmethacrylate, for example, exhibits a coefficient of friction against steel of 0.03 as compared with 0.05 for polytetrafluoroethylene. (Dow Corning Corporation, Dept. S533)

■ TAPE READER will read ten transverse rows of eight holes each in a perforated tape. Standard 1-in. tape with holes on 0.1-in. centers is accommodated. The reader will operate continuously at a rate of 6 frames per second. (California Technical Industries, Dept. S554)

■ RECORDING POTENTIOMETER features two pens, each writing margin-to-margin on a single 5-in. strip chart. Accuracy is ± 0.5 percent, and sensitivity 0.14 percent, of scale span. Input impedance is 1000 ohm/mv. (Westronics, Inc., Dept. S556)

■ AMPLIFIER for low-level signals from thermocouples, strain-gage bridges, and resistance-bridge transducers features floating input. Gain is variable from 5 to 100. Linearity is 0.05 percent, and long-term stability is ± 5 μv. Input impedance is greater than 1.5 Mohm. (Neff Instrument Corp., Dept. S557)

■ PEAK VOLTAGE COMPARATOR measures the ratio of two peak voltages at frequencies up to 1000 cy/sec regardless of phase, frequency, or polarity. The ratio is displayed on a direct-reading dial with accuracy of ± 0.1 percent. (Cal-Tronics Corp., Dept. S536)

■ WINDOWLESS CHROMATOGRAM SCANNER employs a small flow counter with low background. In combination with a scaler, it can count odd-shaped, low-activity samples up to 1 in. in diameter. Operation can be either in the Geiger or the proportional region. (Forro Scientific Co., Dept. S565)

■ ISOLATION AMPLIFIER has selectable bandwidths from 2 cy/sec to 1.7 Mcy/sec. Gain is selectable in decades from 0.1 to 1000. Input impedance is 400 Mohm and 3μμf. Noise is below 10 μv with 150 kcy/sec response. (Keithley Instruments, Inc., Dept. S563)

■ DYNAMOMETER is used as an accessory for determination of power required for mixing non-Newtonian fluids and gas-liquids. The accessory, used with an experimental agitator, transmits motor torque to the pan of a laboratory scale. (Chemineer, Inc., Dept. S541)

■ SIGNAL GENERATOR incorporates a backward-wave oscillator which can be electronically swept to cover the frequency range from 1 to 15 kMcy/sec. Each unit includes modulating circuits, power supplies, and a microwave oscillator. Operation is an 117-v alternating current. (Wave Particle Corp., Dept. S550)

■ DENSITOMETER reads optical density linearly from 0 to 4.0. Color filters, with separate zero adjustments for each filter, permit measurement of colored material. Both reflection and transmission measurements are made. (Macbeth Instrument Corp., Dept. S547)

■ GLASS OBSERVATION WINDOW assembly, of multiple, dry-air insulating construction, is capable of withstanding temperature cycles from − 100° to + 500°F. The units are said to be effective at high altitude and in vacuum. Sizes range from 13 by 13 to 40 by 40 in. (Duo-Pane Corp., Dept. S495)

■ ALTIMETER for altitudes from 75,000 to 225,000 ft is based on the thermocouple vacuum-gage principle. The thermopile elements of the instruments are compensated for ambient temperature and for rate of change of temperature. Response time is a few hundredths of a second. Output is a d-c voltage. Operation is on 115 v a-c. (Hastings Raydist, Inc., Dept. S477)

JOSHUA STERN
National Bureau of Standards

Your key to a new world of enjoyment

An incomparable portable telescope by America's leading manufacturer of astronomical instruments. Although it weighs only 45 pounds its sturdy construction, fork-type mounting and integral electric drive mark it as an instrument of professional quality.

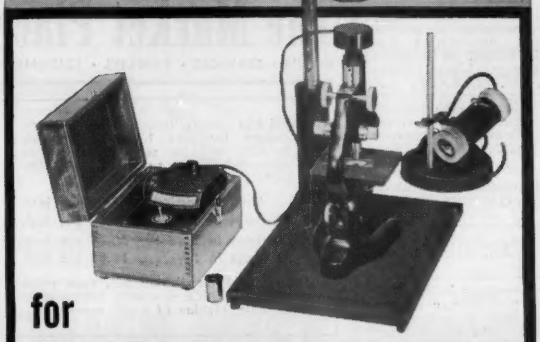
Celestar

Complete with Electric Drive, Slow Motions, Right Ascension and Declination Circles, Heavy Duty Tripod and Finder Telescope.
Magnifications of 35X, 70X, 105X and 210X.

ONLY $198.50 f.o.b. Pittsburgh, Pa.

j. w. fecker, inc.
A Subsidiary of AMERICAN OPTICAL COMPANY
6592 HAMILTON AVENUE • PITTSBURGH 6, PA.

PHOTOVOLT
EXPOSURE PHOTOMETER
Mod. 200-M



for
PHOTOMICROGRAPHY

Accurate determination of exposure time in black-and-white and color photomicrography

Write for Bulletin #810 to **Price $105.00**

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

Searching for One Dependable Source for All Your Research Biochemical Needs

NUTRITIONAL BIOCHEMICALS CORPORATION offers you quality that merits your complete confidence . . . service you can always rely upon . . . plus the economy of lowest possible prices.

A COMPLETE SELECTION OF
MORE THAN 200 AMINO ACIDS AND PEPTIDES
Typical Amino Acids

Glutamine	Valine, D, DL, L
Phenylalanine, D, DL, L	Ornithine, DL, L
Homoserine	Dopa, D, L, DL
Homocysteine	Asparagine, D, L, DL
Histidine	Serine, D, L, DL

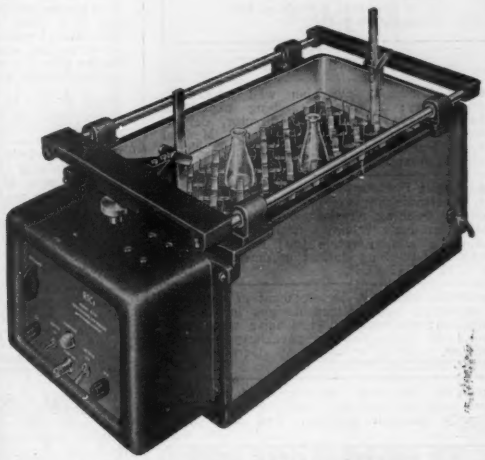
NUTRITIONAL BIOCHEMICALS CORPORATION
21010 Miles Avenue . . . Cleveland 28, Ohio

Write For New Catalog July 1957 Over 1700 Items Write Dept. 102

TEMPERATURE CONTROLLED
WATER BATH SHAKER

Model 2156

RESEARCH SPECIALTIES CO. presents its Model 2156 Water Bath Shaker, a variable speed reciprocating mechanism with a thermostatically controlled heated water bath. Engineered to provide many years of reliable, efficient, trouble-free service, the Water Bath Shaker was designed especially for use in the biological laboratory.



Standard interchangeable trays are provided in several styles to accommodate different sizes of flasks in the reciprocating rack. Racks are easily removable and are adjustable.

- *NEW DESIGN*
- *RELIABLE*
- *ADJUSTABLE*
- *EFFICIENT SERVICE*
- *LOW MAINTENANCE*
- *UNIFORM TEMPERATURE*

WRITE FOR BULLETIN 2156

RESEARCH SPECIALTIES CO.
2005 Hopkins St. Berkeley 7, Calif.

PERSONNEL PLACEMENT

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

COPY for classified ads must reach SCIENCE 2 weeks before date of issue (Friday of every week).

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis — provided that satisfactory credit is established.

Single insertion	**$22.00 per inch**
13 times in 1 year	**21.00 per inch**
26 times in 1 year	**20.00 per inch**
52 times in 1 year	**19.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

Replies to blind ads should be addressed as follows:
Box (give number)
Science
1515 Massachusetts Ave., NW
Washington 5, D.C.

POSITIONS WANTED

Medical Director; physician well trained in pharmacology; 2 years' teaching experience (pharmacology); since 1947, director, department pharmacology, large company. Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

Physiologist–Pharmacologist: Ph.D., physiology, biochemistry–pathology minor; 23 years' research, teaching physiology, pharmacology in medical graduate schools; nearing 45 in predominantly administrative job; desires partial research or teaching duties; minimum $10,500. Box 239, SCIENCE. 8/23

Psychopharmacology. Development of meaningful statistical systems and designs for clinical evaluation; mathematical statistician with background of application in psychiatry, general medicine, and in methods of operations research. Box 236, SCIENCE. 8/30

Virologist: 14 years' experience in research; tissue culture, teaching; publications. Desires primarily research position. Box 242, SCIENCE. X

POSITIONS OPEN

ADMINISTRATIVE ASSISTANT

An educational institution, central New Jersey area, is in need of a female administrative secretary to act as assistant to head of one of its research divisions. Must be college trained, preferably biological sciences, have some experience in secretarial administration, and possess singular capacity for organizing office routine and working competently without supervision. Also essential are good typing skill and familiarity with basic office procedures.

This position offers considerable responsibility and challenge with commensurate salary. The associates are pleasant and the employee benefits liberal. Any who are interested may write to Personnel Office, Rutgers University, New Brunswick, N.J., stating education, experience, age, and other factors which may have further bearing on suitability for this position. X

Biochemist. Ph.D. in biochemical biophysics or enzymology for teaching in Southern medical school. Ample time for own research. Send complete background information. Box 243, SCIENCE. 8/23

PHYSIOLOGISTS
PHARMACOLOGISTS
BIOCHEMISTS

Ph.D.'s in physiology, pharmacology or biochemistry with major background and experience in field of —

(a) Cardiovascular and/or Nutrition
(b) Endocrinology

. . . for team participation in the development of new therapeutic agents. Large pharmaceutical manufacturer. Philadelphia location. Liberal benefit program. Send résumé.

BOX NUMBER 241, SCIENCE

POSITIONS OPEN

Biochemist; M.S. with minor in bacteriology and with good working knowledge of analytic methods for research in fermentation biochemistry. Laboratory is located in Midwest division of national company. Liberal fringe benefits and salary. Box 237, SCIENCE. X

Biochemist. M.S. or B.S. for research position with malting firm in Wisconsin. Industrial experience helpful. Submit résumé of experience and salary requirements. Box 244, SCIENCE. 8/23, 30; 9/6

Director, diagnostic and research tuberculosis laboratory, central Florida, physician or non-physician microbiologist or clinical chemist. Part-time employment will be considered. Write Dr. Albert V. Hardy, Director, Bureau of Laboratories, State Board of Health, P.O. Box 210, Jacksonville, Florida. uc

Editorial Assistant; science-writing background desirable but not necessary; to prepare written descriptions of programs, projects and activities of a State department; edit material for publication; rewrite, and work on weekly newsletter in the science field. Require bachelor's degree plus 2 years of professional writing experience with a Master's degree substituting for 1 year of experience. Salary, $4770 to $5860. Write: Mr. Richard H. Mattox, Director of Personnel, N.Y. State Department of Health, Albany, New York. X

Medical Technicians, General (male) for employment with U.S. Government. Under 38 years of age. Must be U.S. citizen. Military experience in medical field desirable. Knowledge of x-ray and laboratory procedures necessary. Willing to serve overseas. Beginning salary $4080 per annum plus allowances. We request that initial reply include professional background and military experience. Box 235, SCIENCE. 8/16, 23, 30; 9/6, 13, 20, 27

Oceanography—Meteorology. Research assistantships for graduates in chemistry, geology, physics, mathematics, engineering, and biology; $1800 to $3000. Write Department of Oceanography and Meteorology, Texas A. & M. College, College Station, Texas. 8/23

(a) Organic chemist, Ph.D. or M.Sc.; qualified to conduct organic synthesis in medicinal chemistry with minimum supervision; research laboratory specializing in organic synthesis in medicinal chemistry; Pacific Coast. **(b) Junior clinical chemist** interested in analytical clinical chemistry as lifetime career, capable of research in methodology improvement; research laboratories established 30 years; East. **(c) Director,** agricultural development staff; should be competent public speaker; considerable travel; D.V.M. required; international chemical and pharmaceutical manufacturing company. **(d) Late calls** for scientists qualified to teach anatomy, biology, genetics, embryology, microbiology, physiology, zoology; ranks dependent qualifications; various locations. S8-3 Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

Research assistant for biochemical-histochemical studies on developmental endocrinology. Good training in chemistry desirable. Salary dependent on qualifications. Write F. Moog, Zoology Dept., Washington Univ., St. Louis 5, Mo. 8/23, 30; 9/6

Research Director is being sought by a Midwest pharmaceutical firm with 200 employees. Applicant must have Ph.D. Duties involve supervision of basic, clinical, and market research. Box 238, SCIENCE. 8/23, 30; 9/6

SCIENCE TEACHERS, LIBRARIANS, ADMINISTRATORS urgently needed for September positions in many states and many foreign lands. No fees. Apply direct. Also study awards. Rush $1 for complete job data, salaries. CRUSADE, SCI, Box 99, Station G, Brooklyn 22, N.Y. EW TF

SCIENTIST

Ph.D. in physiology or pharmacology to assist in the evaluation of neuropharmacologic agents for use in mental illness in research activities of Philadelphia pharmaceutical manufacturer. Liberal benefit program. Send detailed résumé.

BOX NUMBER 240, SCIENCE

The Market Place

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis — provided that satisfactory credit is established.

Single insertion	**$22.00 per inch**
13 times in 1 year	**21.00 per inch**
26 times in 1 year	**20.00 per inch**
52 times in 1 year	**19.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . . **SCIENTIFIC PERIODICALS and BOOKS** — Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted.
WALTER J. JOHNSON, INC.
111 Fifth Avenue, New York 3, New York

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, Inc. Boston 19, Massachusetts

SCIENTIFIC JOURNALS WANTED

Sets, Runs and Volumes bought at top prices. —— Your wants supplied from our Back Files of over 3,000,000 periodicals. Abrahams Magazine Service; N. Y. 3, N. Y.

PROFESSIONAL SERVICES

TRUESDAIL LABORATORIES, INC.
Chemists • Bacteriologists • Engineers
Request Brochure and Publication
CHEMISTRY IN ACTION, on letterhead
4101 No. Figueroa Street, Los Angeles 65, California CA 6-4148
HAWAIIAN DIVISION Honolulu, Hawaii
Roger W. Truesdail, Ph.D., President
C. E. P. Jeffreys, Ph.D., Technical Director

SUPPLIES AND EQUIPMENT

HOLTZMAN COMPANY

. . . continuous group uniformity

Rte. 4, Box 205 Madison, Wis.

Phone ALpine 6-5573

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

SUPPLIES AND EQUIPMENT

albino rats *

Hypophysectomized Rats

*Descendants of the Sprague-Dawley and Wistar Strains

"From the hand of the veterinarian to research"

HENRY L. FOSTER, D.V.M.
President and Director
THE CHARLES RIVER BREEDING LABS.
Dept. B, Wilmington, Mass.

SWISS MICE

BACTERIOLOGICAL AND GROSS TISSUE STUDY TECHNIQUES USED IN OUR QUALITY CONTROL

HUNTINGDON FARMS, INC.
2548 NORTH 27th ST. PHILA. 32, PA.

ALBINO RATS

Our mass production methods insure greatest uniformity and consistency

Price list on request

DAN ROLFSMEYER CO. ■ Ph. 6-6149
Route 3, Syene Road, Madison, Wisconsin

BOOKS AND MAGAZINES

PSYCHOPHARMACOLOGY

AAAS Symposium Volume
edited by
Nathan S. Kline

6" x 9", clothbound, 175 pp., bibliographies, index, 1956
$3.50 ($3.00 for cash orders by AAAS members)

This volume consists of material presented at the first major conference on the remarkably successful use of new drugs such as chlorpromazine in the treatment of mental disease.

"The authors are competent and careful workers who have approached this problem with a scientific attitude . . . Throughout the volume runs the thread of caution . . . New vistas are being opened for the psychiatrist, the neurologist, the physiologist, the psychologist, the pharmacologist and the chemist." Foreword, Winfred Overholser.

"This volume is not a reference intended for use at the introductory student level. It can be reviewed with interest, however, by any serious member of the reading public." *American Journal of Pharmaceutical Education,* July 1956.

At all book stores or write

American Association for the Advancement of Science
1515 Massachusetts Ave., NW
Washington 5, D.C.

SUPPLIES AND EQUIPMENT

SWISS — WEBSTER
MICE
ARMER ENTERPRISES
Croton Falls, N.Y.

YOU can TELL and SELL more than 33,500 scientists here . . . at a very low cost.

Your sales message in an ad this size costs only $55.00 at the one-time rate—less for multiple insertions. And the results!—well, here's what one of the many satisfied advertisers in SCIENCE has to say . . .

"SCIENCE is consistently our most profitable medium. Business secured solely thru SCIENCE ads has been the backbone of our success in this field."
"We carry a considerable amount of advertising in various periodicals, but none is so productive of results as SCIENCE."

Prove to yourself the effectiveness of SCIENCE in increasing your Market, Sales and PROFITS—send your "Copy" NOW—or write for further information and Rate Card No. 29-A.

SCIENCE 11 West 42 St. New York 36, N.Y.

SWISS MICE

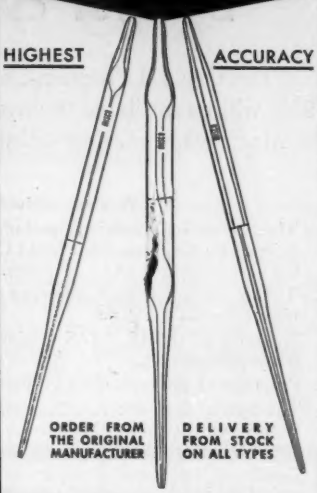
TACONIC FARMS
GERMANTOWN NEW YORK
GERMANTOWN 3535

Send for booklet

SUPPLIES AND EQUIPMENT

MICRO PIPETS

HIGHEST ACCURACY



ORDER FROM THE ORIGINAL MANUFACTURER

DELIVERY FROM STOCK ON ALL TYPES

MICROCHEMICAL SPECIALTIES CO.
1034 UNIVERSITY AVENUE ○ BERKELEY 3, CALIFORNIA

SPRAGUE-DAWLEY, INC.

PIONEERS IN THE DEVELOPMENT OF THE STANDARD LABORATORY RAT

OUR PLEDGE: Our insistence on the highest possible quality will never be sacrificed to quantity.

Sprague-Dawley, Inc.
P.O. Box 2071
Madison 5, Wisconsin
Phone: CEdar 3-5318

GET YOUR ADVANCE COPY

of the General Program-Directory of the AAAS Indianapolis Meeting by first class mail – early in December

The General Program-Directory of the 124th Meeting of the AAAS in Indianapolis, Dec. 26–30, 1957, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The two-session general symposium, "Moving Frontiers of Science II: Concepts That Mold Our Lives," arranged by the Committee on AAAS Meetings.
2. The six sessions of the Conference on Scientific and Technical Editorial Problems.
3. Programs of the 18 AAAS sections (symposia and contributed papers).
4. Programs of the more than 60 participating societies.
5. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Manpower, National Geographic Society, Phi Beta Kappa, Sigma Xi-RESA.
6. Details of the Murat Temple—center of the Meeting—and of the hotels and other session sites.
7. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
8. Exhibitors in the 1957 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1957.
2. Complete roll of AAAS presidents and their fields.
3. The 271 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

Advance Registration

Advance registration has these decided advantages: 1) You avoid delay at the Registration Center upon arrival; 2) You receive the General Program-Directory in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; 3) Your name is posted in the Visible Directory as the Meeting opens.

The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program-Directory.

— THIS IS YOUR COUPON FOR AN ADVANCE COPY OF THE GENERAL PROGRAM-DIRECTORY —

1a. ☐ Enclosed is $3.00 for my advance Registration Fee which brings me the Program-Directory, Convention Badge, and all privileges of the Meeting.

1b. ☐ Enclosed is $2.00 for only the Program-Directory. (It is understood that, if I should attend the Meeting later, the Badge—which is necessary for all privileges of the Meeting—will be secured for $1.00 more.)
(Check one)

2. FULL NAME (Dr., Miss, etc.) .....
(Please print or typewrite) (Last) (First) (Initial)

3. ACADEMIC, PROFESSIONAL, OR BUSINESS CONNECTION .....

4. OFFICE OR HOME ADDRESS .....
(For receipt of Program-Directory)

5. YOUR FIELD OF INTEREST .....

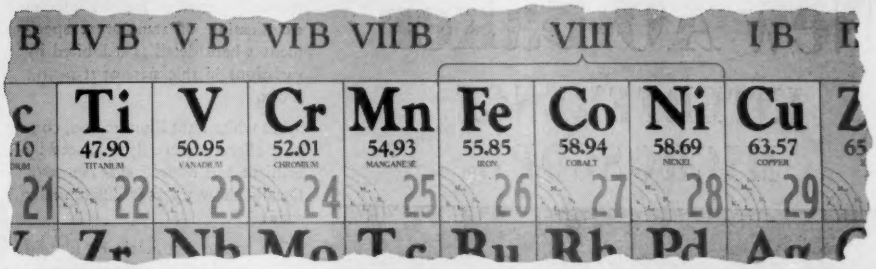
6. CONVENTION ADDRESS .....
(May be added later, after arrival)

Please mail this Coupon and your check or money order for $3.00 or $2.00 to the
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1515 Massachusetts Avenue, N.W., Washington 5, D.C.

QUICK DETECTION OF PARAMAGNETIC IONS

E-P-R AT WORK **7**

(Electron Paramagnetic Resonance)


B IV B V B VI B VII B VIII I B
Ti 47.90 TITANIUM 22
V 50.95 VANADIUM 23
Cr 52.01 CHROMIUM 24
Mn 54.93 MANGANESE 25
Fe 55.85 IRON 26
Co 58.94 COBALT 27
Ni 58.69 NICKEL 28
Cu 63.57 COPPER 29
21
Zr Nb Mo Tc Ru Rh Pd Ag

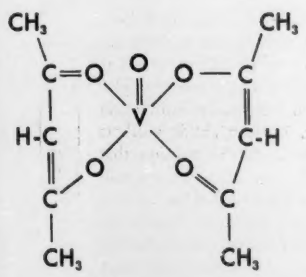
Where a trace of a transition element ion constitutes either a harmful impurity or a key to a chemical, physical or biological phenomenon, quantitative determination by E-P-R spectroscopy has a number of advantages. The test is fast and non-destructive. A typical sample size is 0.1 cc and the method is effective on concentrations as low as 10^{-6} molar. On a routine basis a quantitative E-P-R test can be made in a few minutes. The same results by chemical analysis might require hours or days of painstaking effort.

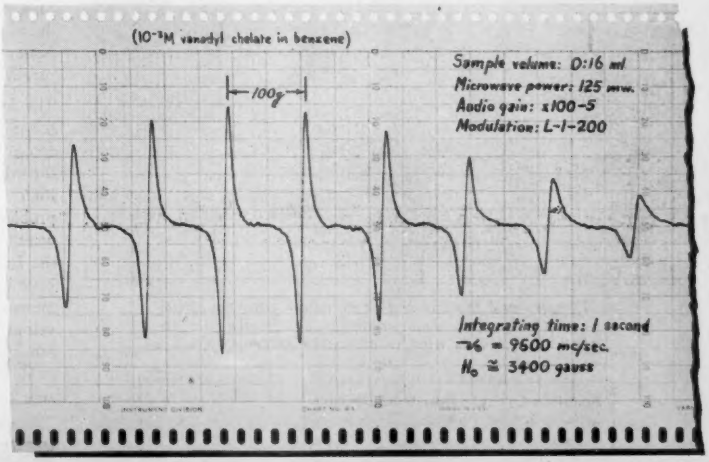
E-P-R Spectroscopy is effective on most transition element ions because the unfilled electronic shell causes the ion to be paramagnetic. Each ion yields a characteristic E-P-R spectrum which identifies its presence and concentration. By further interpreting this spectrum, the scientist can also determine configuration mixing and magnitudes and symmetries of microscopic electrostatic fields at the paramagnetic ion site. An example is shown below.

Number 7 of a series **PARAMAGNETIC RESONANCE ABSORPTION IN VANADYL CHELATE**

INTERPRETATION: Metallo-organic compounds are of great interest in biochemistry and chemistry. The subclass of compounds called "chelates" offers many practical applications for EPR in determinations of structure, valence states, and qualitative and quantitative analyses. The spectrum recorded from V^{4+} in vanadyl acetyl acetonate is shown below.

The eight lines result from the $2I+1$ equally probable orientations of the $(I=7/2)$ V^{51} nucleus, and all apparently have the same absolute intensity despite the assymmetry. The variation in these differentiated signals is due to variation in the line-widths — a phenomenon which reveals the contribution of the hyperfine interaction to the electronic relaxation.

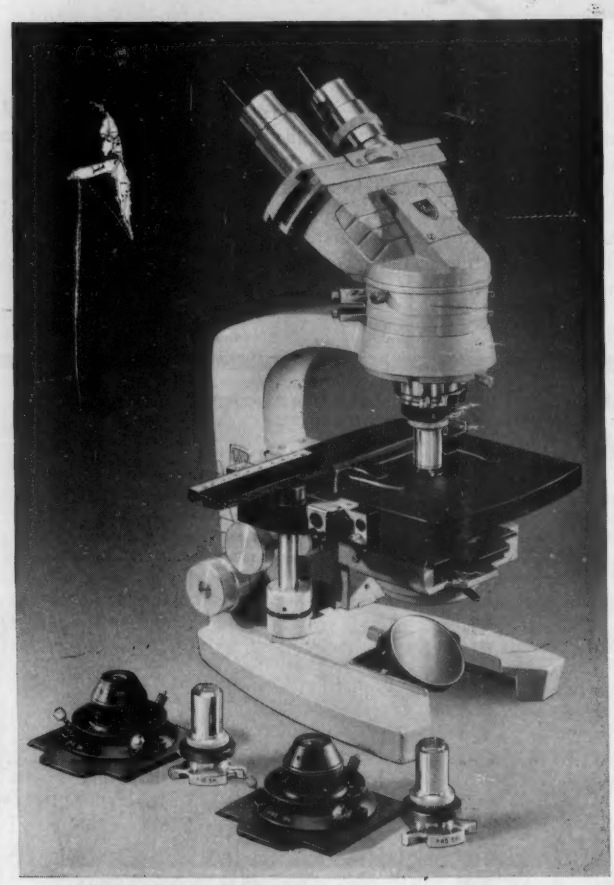




For full technical details on E-P-R and N-M-R Spectroscopy and Spectrometers, write to the Varian Associates Instrument Division

VARIAN associates
INSTRUMENT DIVISION
PALO ALTO 18, CALIFORNIA

New AO-Baker
INTERFERENCE MICROSCOPE



If you need to examine or measure your material more effectively and precisely, we invite you to investigate this new advance in microscopy.

American Optical • Instrument Division
Buffalo 15, New York
Dept. T-3

Please send me your catalog on the NEW AO-Baker Interference Microscope.

NAME_____

ADDRESS _____

CITY_____ ZONE____ STATE____

The NEW AO-Baker Interference Microscope is the unique combination of a double beam interferometer and polarizing microscope. It dramatically provides for the precise examination of transparent specimens where detail is exhibited by variations in thickness or refractive index.

With white light illumination, contrast effects are greatly enhanced by brilliant and *variable color contrasts.* Details show up as if differentially stained.

With monochromatic or filtered light, interference contrasts can be varied from bright to dark and relative optical thicknesses are measurable to an optimum accuracy of 1/300 wave length.

Interference Contrast Microscopy like Phase Contrast Microscopy depends on the nature of the specimen detail to retard light—by virtue of refractive index and thickness—and does not depend on the property of the specimen to absorb light. In this connection the AO-Baker Interference Microscope is similar to the conventional Phase Contrast Microscope.

The principle of the Phase Contrast Microscope depends upon light diffraction for its contrast effects—the AO-Baker Interference Microscope does not. By means of the unique built-in interferometer, mutually interfering beams are produced, recombined, and if the two beams suffer relative retardation, readily visible contrast results.

The AO-Baker Interference Microscope has already won acclaim and recognition as an important aid to the solution of a great variety of biological and industrial microscopical problems. Most scientific workers were *initially* of the opinion that the Interference Microscope would have its greatest utility for solving measurement problems. It now develops that equal or greater promise can be expected from its value as a method of variable phase and variable color contrast.

American Optical Company

INSTRUMENT DIVISION, BUFFALO 15, NEW YORK